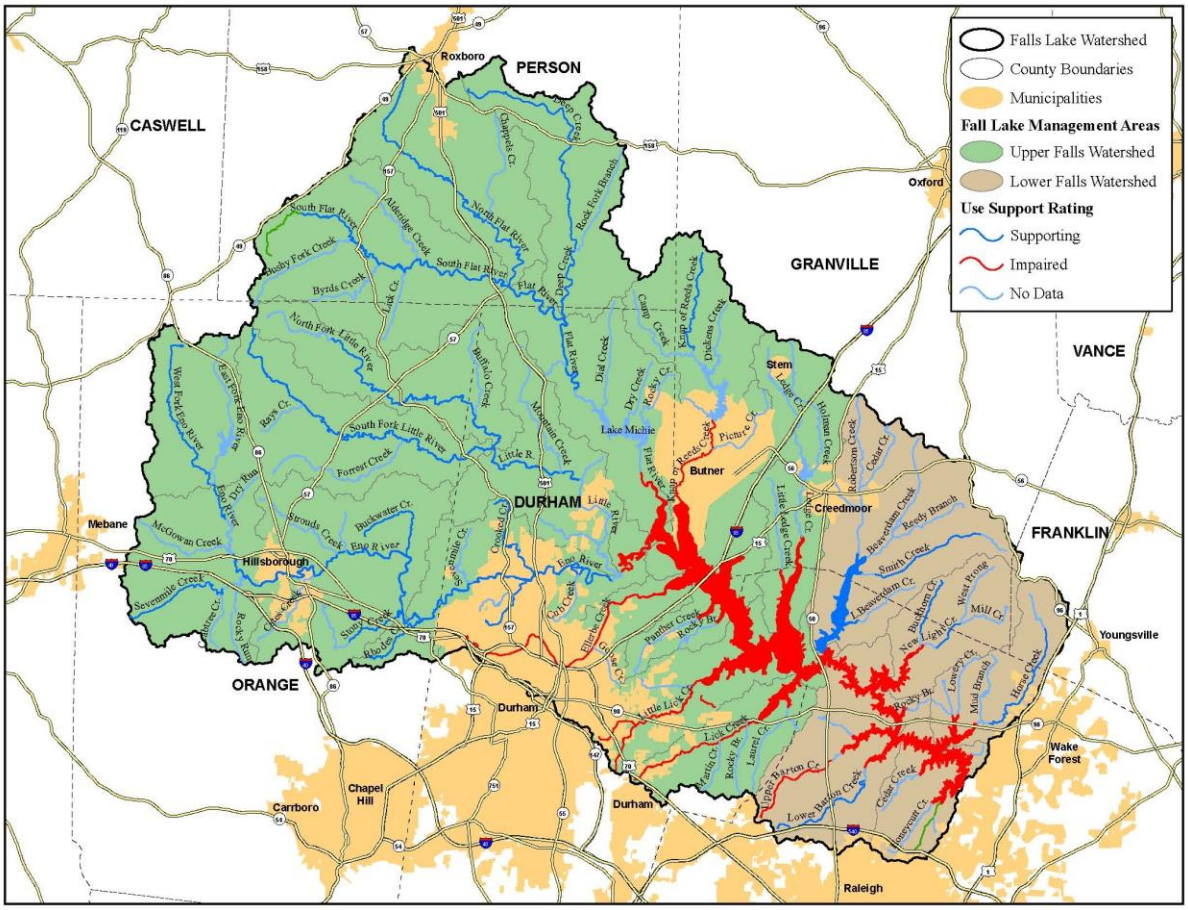
Fiscal Analysis
For Proposed Nutrient Strategy
For Falls of Neuse Reservoir



June 14, 2010

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Summary

Fiscal Analysis
Falls of the Neuse Reservoir Water Supply Nutrient Strategy

History: In 2005 the NC General Assembly passed SL 2005-190 (S981), which includes a requirement for the Commission to adopt a nutrient strategy for Falls Lake. The 2009 regular session produced Senate Bill1020, a bill devoted to water quality improvements in Falls Lake. This bill revises the EMC adoption deadline to January 15, 2011 and adds certain requirements aimed at water quality improvement in the watershed. The bill was ratified and signed into law on August 26, 2009. A stakeholder meeting process began in late 2008 to provide input on draft rule language. The ninth and final stakeholder meeting was held on January 21, 2010 to review proposed draft rule language and receive additional comments. Staff requested approval to take draft rules to public hearing at the March 2010 EMC meeting.

Strategy Synopsis and Status

The proposed Falls Reservoir Water Supply Nutrient Strategy is a comprehensive set of rules designed to address excess nutrient inputs to Falls Lake that can lead to algae blooms and other water quality problems. Falls is an impoundment in the upper Neuse River Basin in the central Piedmont that drains a mixture of agricultural and urbanized lands. The lake is a major recreational amenity for the area and serves as the main water supply for approximately 450,000 residents of the City of Raleigh and several other Wake County municipalities.

The rules are similar to those already in place in the Jordan Watershed and Neuse and Tar-Pamlico River Basins and are adapted to Falls Reservoir and its watershed. The rules would require all major sources of nutrients to implement a staged, adaptive approach to reducing their nitrogen and phosphorus loads to Falls Lake by 40% and 77%, respectively from a 2006 baseline condition. Modeling has projected that these reductions would restore water quality standards and full uses of the lake. The strategy is comprised of two stages of 10 and 15 years duration respectively. The objective of the first stage is to recover water quality in the lower portion of the lake. It imposes requirements across the lake's entire watershed. The second stage is designed to recover water quality in the upper portion of the lake as well, and places additional requirements on parties in the upper watershed only.

Nutrient sources addressed by the rules include agriculture, fertilizer application, wastewater discharges, and stormwater runoff from both new development and existing developed lands. As in the Jordan Lake watershed, a strategy for existing development was needed in the Falls watershed because of the significant nutrient contributions from developed lands. Also as in Jordan, a separate trading rule would enable use of more cost-effective management options to meet strategy goals.

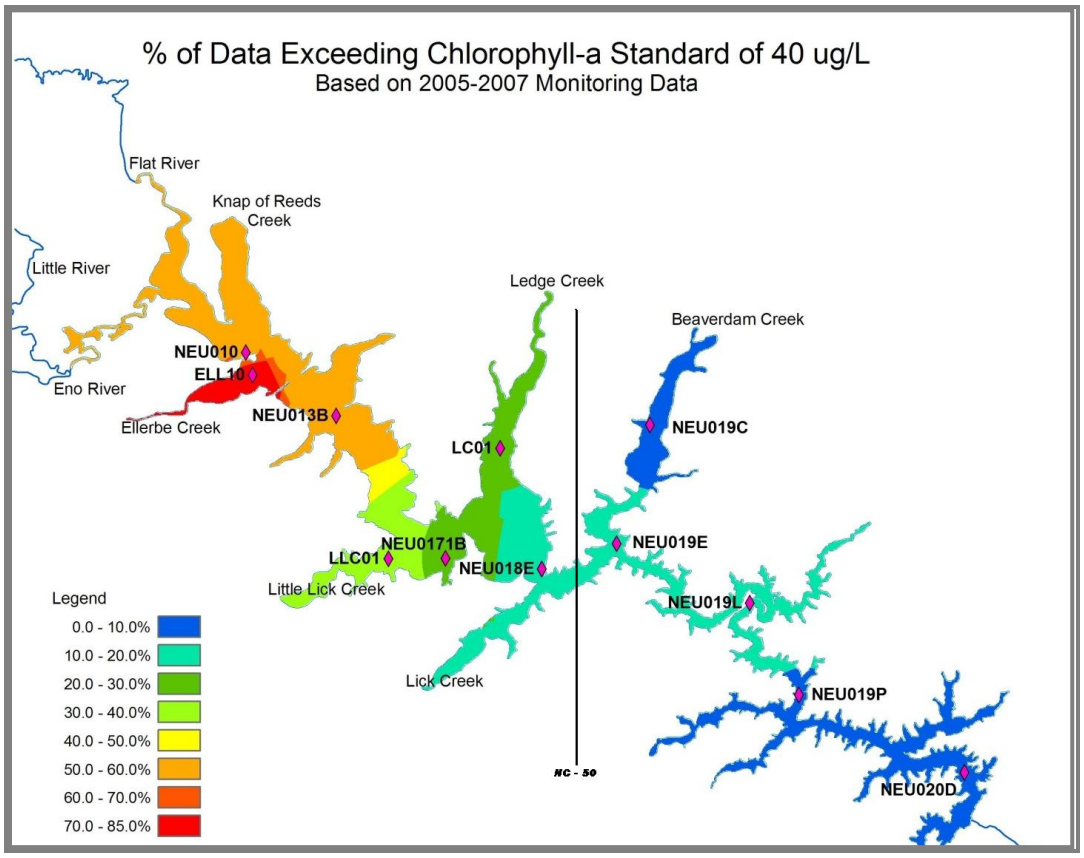
A set of nine draft Falls Lake nutrient rules was approved by the Environmental Management Commission in March 11, 2010 to be taken out to public hearing and comment. Legislation requires that the EMC adopt the final rules no later than January 15, 2011. Approval of this fiscal analysis will allow the Division of Water Quality to initiate the public comment period.

Summary

Lake Water Quality Background: Following questions in 2004 over the condition of Falls Lake, DWQ began more intensive sampling to assess whether the lake was meeting water quality standards and to support development of lake and watershed models. A Falls Lake Technical Advisory Committee (TAC) was formed in July 2005 to assist DWQ with the review and modification of the monitoring strategy and developing levels of confidence for decision making associated with the monitoring and lake modeling activities. The field study was completed in fall 2007. Based on water quality data collected between 2002 and 2006, Falls Lake was listed as impaired for chlorophyll-*a* on the NC 2008 303(d) list. Chlorophyll-a is a measure of algal productivity, which reflects levels of nutrient inputs to the lake. The 303(d) list is a list of impaired waters which are not meeting water quality standards and require a Total Maximum Daily Load, which is the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards. The portion of the lake above I-85 was also listed as impaired for turbidity.

Data collected by DWQ indicate that the North Carolina chlorophyll-*a* (chl-a) standard (no greater than 40 µg/L) has been frequently violated in Falls Lake, with higher standard violation rates observed at the upper part of the lake, above NC 50. Figure I. illustrates high levels of algal production in the upper lake, which generally decreases moving down-lake toward the dam.

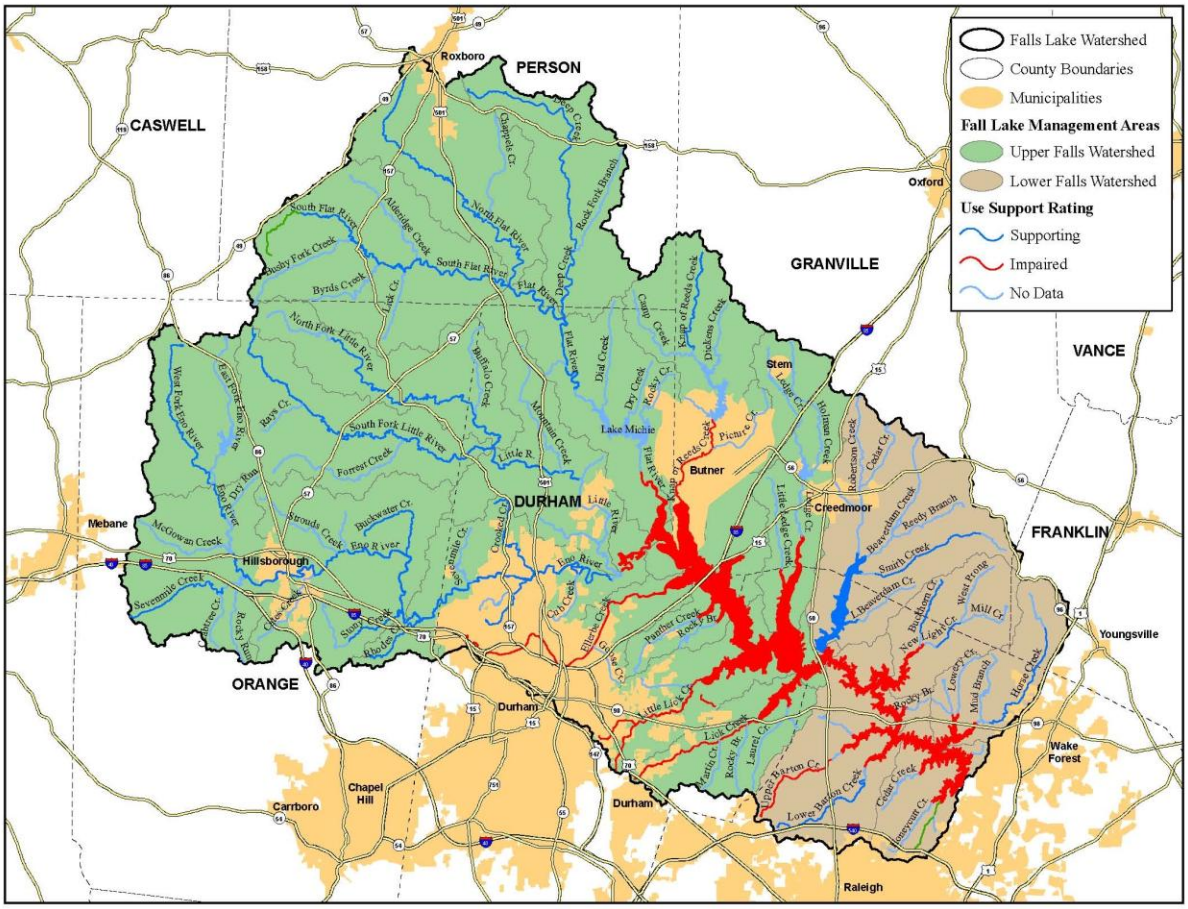
Figure I. Distribution of Algal Production in Falls Lake as Measured by Chlorophyll-a Concentrations, 2005-2007



Summary

***Watershed Background*:** The 770 square-mile Falls Lake Watershed, also referred to as Neuse River Subbasin 03-04-01, is located in the northeastern Piedmont of North Carolina and makes up the northern portion of the Neuse River Basin. The watershed spans portions of six counties including parts of Durham and Raleigh. Over 90,000 people reside in the watershed with the population projected to double by the year 2025. The Raleigh-Cary area was the fastest growing metro area in the country between years 2007 and 2008 with a 4.3 percent population increase (U.S. Census, 2009). Nine water supply reservoirs in the watershed, including Falls Lake, serve 450,000 people (NC DWQ, 2008). Land cover in the watershed is approximately 58 percent forest, 18 percent agriculture, and 11 percent developed.

Figure II. Falls Lake and Its Watershed



Nutrient Loading to Falls Lake: Nutrient loads are produced by various sources in the watershed, including both wastewater dischargers, and "point sources", and diffuse inputs from land uses and atmospheric deposition, collectively referred to as "nonpoint sources". The delivered total nitrogen (TN) and total phosphorus (TP) loading estimated by the watershed model from the upper five major watersheds in the Falls Lake watershed are shown in Figure 3 and Figure 4, respectively. High nutrient loading leads to high Chl-a concentrations, a measure of algal growth. The details of the delivered nutrient loading estimates from each of the five subwatersheds are given in the Falls Lake watershed model report (NC DWQ, 2009a).

Figure III. Nitrogen Loading to Falls Lake

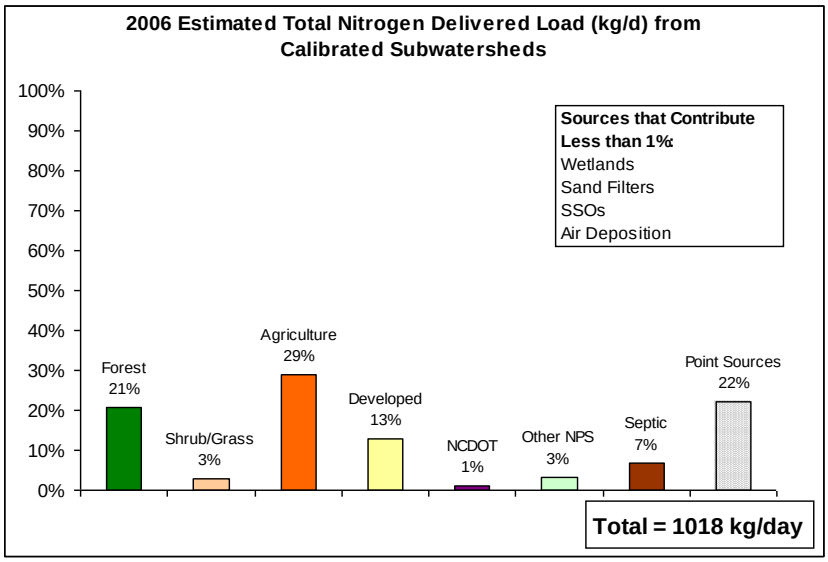
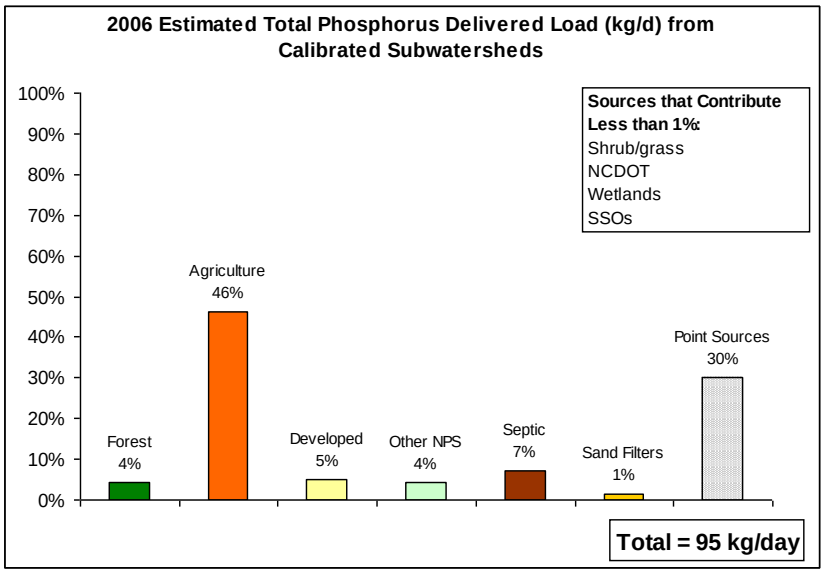


Figure IV. Phosphorus Loading to Falls Lake



Stakeholder Process: A watershed and lake model were completed by DWQ staff in November 2008 and February 2009 respectively and presented to the TAC for their review. A stakeholder process conducted through a joint effort between the Triangle J Council of Governments (TJCOG) and DWQ began meeting in August 2008 to provide stakeholders an opportunity for input on development of a nutrient strategy for the lake. The stakeholder group completed a series of nine meetings throughout 2008, 2009, and 2010. The group gained an understanding of lake issues, modeling basics and results, and grappled with strategy

design issues and options. Presentations and meeting summaries are posted to a Falls Lake stakeholder website hosted by TJCOG. An online discussion forum, known as a "wiki", was also created to provide stakeholders an open forum to raise questions and exchange information between meetings.

The stakeholder group broke into four smaller subcommittees that held a total of twelve meetings between September 17th and December 7th, 2009 to work on detailed nutrient reduction rule ideas by source type. In late November and early December draft rules addressing new development stormwater, existing development, agriculture, and point sources were provided to stakeholders for their review with comments due back to the Division by December 23, 2009. DWQ made further revisions to the draft rules based on these comments and provided revised rules to stakeholders on January 14th. The full stakeholder group reconvened on January 21, 2010 to review the revised rule language and provide further input. After the meeting, stakeholders had the opportunity to provide additional written comments to DWQ by January 29, 2010. Additional revisions have been made to the rules based on this latest round of stakeholder comments and are reflected in the draft rules submitted to the March 2010 Environmental Management Commission for approval to go out to public hearings.

Nutrient Management Strategy Design: The strategy is designed to achieve an overall 30% reduction in nitrogen loading and 70% reduction in phosphorus loading to Falls Lake, which is to be accomplished by requiring regulated sources to reduce their nitrogen loadings to the lake by 40% and phosphorus loadings by 77%. The strategy calls for reductions to be achieved over two stages of implementation. Stage I requires initial reductions watershed-wide to ensure the chlorophyll-a standard is met in the lower lake by 2021. Stage II calls for additional reductions in upper watershed (area above NC 50) by 2036 to ultimately achieve the chl-a standard lake-wide by 2041.

The strategy targets all of the major nutrient contributors throughout the watershed. In their draft form, there are 9 new rules in all and two Neuse rule amendments. The new rules include a purpose and goals rule, a definitions rule, rules for each major source type, and a trading rule. In terms of individual sources, the Wastewater Discharge Rule sets annual mass allocations for existing wastewater dischargers in the watershed. Several rules require stormwater controls to reduce nutrient load coming from new and existing developed lands, including state and federally owned lands. There is also a rule that addresses fertilizer application throughout the watershed. The Agriculture Rule establishes collective nutrient reduction goals for all persons engaging in agricultural operations in the watershed.

Rules

The following is a brief content summary of each of the nine draft rules and two rule amendments. All rules will fall under Title 15A NCAC, Chapter 2B.

Rule .0275, Purpose and Scope
Describes strategy purpose, scope, and objectives; identifies the set of rules comprising the strategy; designates Falls watershed as a 'critical water supply watershed', which allows the EMC to require more stringent measures than minimum Water Supply Watershed requirements; defines geographically the "Upper Watershed" and "Lower Watershed"; identifies the baseline time period; establishes nitrogen and phosphorus (N and P) percentage reduction goals and corresponding point and nonpoint source lake loading targets relative to the baseline; establishes that all local governments – six counties and eight municipalities– are subject to certain rules; and provides for a two stage adaptive management approach. Stage I calls initial reductions watershed-wide to ensure the chlorophyll-a standard is met in the lower lake by 2021. Stage II calls for additional reductions in upper watershed (area above NC 50) to ultimately achieve the chl-a standard lake-wide by 2041.

Rule .0276, Definitions
Defines terms that apply across rules and are specific to the set of Falls rules.

Rule .0277, Stormwater Management for New Development
Requires all local governments in the Falls watershed – six counties and eight municipalities – to implement stormwater programs for new development activities. Those programs must be designed to meet nutrient loading rate targets (2.2 lbs/acre/year Total Nitrogen (TN) and .33 lbs/acre/year Total Phosphorus (TP)). Developers will be required to control nutrient export to certain levels onsite, but can meet remaining reduction needs through offsite measures including payment of fees for nutrient offset projects or through purchase of reduction credits from private sellers pursuant to the Falls trading rule .0282. Within two months after effective date, the Division submits a model local program to the EMC for approval. Within another five months, local governments submit programs for Division review and EMC approval. Within eighteen months after effective date, local governments implement permitting requirements. Annual reports are required.

Rule .0278, Stormwater Management for Existing Development
The rule requires all local governments in the watershed to develop and implement within three years of rule effective date a Stage 1 load reduction program to reduce loading from existing developed lands to 2006 baseline levels by 2021. Stage II load reduction plans would be required for local governments with jurisdictions including land located in the upper watershed. Stage II load reduction programs will include compliance timeframes proposed by the local government and shall meet explicit criteria established in the rule. Local governments are required to submit revised plans for EMC approval every five years. The Commission will approve load reduction plans that it finds achieve the maximum level of reductions that is technically and economically feasible within the proposed timeframe of implementation based on plan elements identified in the rule.

Rule .0279, Wastewater Discharge Requirements
Distributes the total point source annual N and P mass loading goals in the form of annual mass allocations to three existing large wastewater dischargers ($\geq$0.1 Million Gallons per Day (MGD)) in the upper watershed and establishes concentration limits for two large private plants in the lower watershed. In the upper watershed, Stage I of implementation will establish mass allocations based on a 20% reduction in TN and 40% reduction in TP to be achieved by 2016, and Stage II will establish mass allocations based on a 40% reduction in TN and 77% reduction in TP to be achieved by 2036. As in the Neuse River Basin nutrient strategy, there are provisions for new and expanding discharges; an option for group compliance; and potential for in-lieu fee payments to offset exceedance of the annual loading cap. There is also an option for transfer of allocation among individual dischargers.

Rule 0280, Agriculture
Establishes collective nitrogen and phosphorus reduction goals for agricultural operations in the watershed to be achieved in two stages. Stage I establishes reduction goals of 20% TN and 40% TP to be collectively achieved by agriculture by 2021. Municipal residual application operations will also be required to use Realistic Yield Expectation nitrogen application rates and to run and comply with the Phosphorus Loss Assessment Toll (PLAT) by the end of Stage I. Stage I calls for reduction goals of 40% TN and 77% TP to be collectively achieved by agriculture by 2036. Stage II will also require the buffering of all cropland and buffers and exclusion on all pasture if agriculture does not achieve their Stage I goal. Three years after effective date, the Watershed Oversight Committee (formed by the Director) will determine the extent to which the nitrogen goal has been achieved relative to the baseline period. If the goal has not been achieved, the report shall include an assessment of the practicability of producers achieving the Stage I objective within ten years after the rule effective date, and recommendations to the Commission. Annual reports are required.

Summary

Rule .0281, Stormwater Requirements for State and Federal Entities
Establishes stormwater requirements for state and federal entities that are similar those imposed on local governments for both new and existing development under rules .0277 and .0278. The NC DOT is treated differently than other state/federal entities based on the unique character of its activities. Annual reports would be required. New DOT road projects would be deemed compliant if they meet buffer protection rule treatment criteria. DOT is also given the option of implementing a combination of six stormwater retrofits per year for existing roadway development and other load-reducing measures identified in the program to control loading from existing development pursuant to .0278.

Rule .0282, Options for Offsetting Nutrient Loads
Provides parties subject to the various rules - new development, existing development, State and Federal stormwater entities, agriculture, and point sources – the option to obtain more cost-effective reductions by purchasing reduction credit from other, offsite reduction sources or private sellers. This open, market-based framework provides options in addition to the NC EEP option currently used in the Neuse and Tar-Pamlico strategies. It requires that minimum onsite standards be met before seeking credit elsewhere. It sets criteria for those seeking to sell excess reductions, and would require Division approval. It also establishes geographic restrictions on trading.

Rule .0283, Fertilizer Management
Beginning three years after effective date, the application of fertilizer to lands in the watershed is to be done either by applicators that have completed nutrient management training offered by the Cooperative Extension Service, or pursuant to a certified nutrient management plan developed for the lands to which fertilizer is applied. Also requires property owners to ensure that applicators to their lands have met one of these requirements. The rule does not apply to fertilization of residential lands done by the homeowner. Wastewater residuals and septage application have earlier compliance timeframes. Animal waste application in compliance with a permitted waste utilization plan is deemed compliant.

Amended Rules: *(These rule amendment are administrative in nature and do not increase costs)*

Rule .0235, Neuse New Development Stormwater Rule
The rule is amended to clarify that the Falls lake requirements supersede the Neuse stormwater rules for local governments located in the Falls Watershed.

Rule .0315, Neuse River Basin (Schedule of Classifications)
The rule amendment formalizes the reclassification of the non-Water Supply Watershed portions of the Falls watershed to WS-V and designates the entire watershed as Critical Water Supply Watershed.

Summary

Table I. Fiscal Analysis Basics, Falls Nutrient Rules

2B	Rule Name	Regulatory Baseline	Affected Parties & Cost Types
.0275	Goals	N/A	None
.0276	Definitions	N/A	None
.0277	New Development*	Vast majority of watershed is classified as WS-IV: 1 BMP required if > 24% bua, 70% bua cap. Only Local Gov't not classified as WS is Hillsborough, but has NPDES Stormwater Phase II requirement: 1 BMP if > 24% bua. Also, growth areas (Durham, Durham Co, Raleigh, Wake Co, Orange Co, Hillsborough (elective)) - Neuse Stormwater: 3.6 lb N/ac/yr loading rate. (Few low/no-growth areas more stringent WS) (Several other Local Gov'ts have Phase II: adds no new development requirements over WS)	Developers: Cap, RT, Plan, Property Buyers: O&M Local Gov'ts: RD, Mon, Perm, Insp DWQ: Opp
.0278	Existing Development	WSW controls required on development since ~1992. Neuse stormwater since 2001. NPDES Ph.II	Local Gov'ts: Plan, Cap, O&M, RT DWQ: Opp
.0279	Wastewater	Domestics > .5 MGD - Neuse WW rule: 5.5 mg/l TN @ 1995 permitted flow. Domestics > .05 MGD – Neuse WW rule: 2.0 mg/l TP. Domestics < .05 MGD – NPDES permits	Local Gov'ts: Plan, Cap, O&M Private Domestic: Plan, Cap, O&M
.0280	Agriculture	CAFO's - DWQ permits: waste utilization plans, 25' setbacks. Crop farmers collectively - Neuse Ag rule: maintain > 30% reduc from '95.	Farmers: Cap, O&M, Opp DSWC, SWCDs, NCDA: Opp DWQ: Opp
.0281	State & Federal Entities	DOT - NPDES permit: 14 retrofits/yr statewide, no obligation in Falls. DOT - Neuse buffer rule: diffuse flow to buffer or treat.	DOT: Plan, Cap, O&M, RT Other State: Plan, Cap, O&M, RT Fed: Opp DWQ: Opp
.0282	Options for Offsetting Loads	N/A	None
.0283	Fertilizer Management	CAFO's - DWQ permit: waste utilization plans. All others applying fertilizer 1998-2003 who did not take Neuse Nutrient Management training - follow certified NM plan.	CAFO's: None Farmers: Opp Commercial Turf: Opp Local/State Gov'ts: Opp DWQ, CES, DSWC, NCDA: Opp

*BMP = best management practice; bua = built upon area;

Cost Types

Cap -	Capital	RD -	Regulatory Development
Plan -	Planning	Mon -	Monitoring & Recordkeeping
O&M -	Operation & Maintenance	Perm -	Permitting
RT -	Regulatory Transaction	Insp -	Inspection & Enforcement
Opp -	Opportunity Cost		

Costs to Affected Parties

This section provides a summary of costs related to the implementation of the proposed rules of the Falls Lake nutrient management strategy. The subsequent section summarizes benefits of the proposed strategy. A full discussion of the costs associated with each individual rule follows in the subsequent chapters.

***Costs Calculated**:* Costs are provided below for all ten years of Stage I. Stage I is expected to begin in early 2011 following EMC adoption of the temporary rules, and to run through 2020. In addition, total net present value costs for each of Stage I, Stage II, and Stages I + II are provided below. Stage II costs would be incurred through 2035. Where possible for any cost element, we provide a low-to-high cost range.

Costs were calculated for all affected parties. Table II summarizes costs across all rules for each of the following parties: private, state, federal, and local government. In addition, individual chapters discuss the impacts of each rule on small businesses. We found that two rules will have significant impact on small businesses, the Agriculture and New Development Stormwater Rules. In both cases, most or all private costs are to small businesses.

Given the long-term nature of these rules, cost projections for Stages I and II are presented using Net Present Values (NPV), which is a process that takes into account the time value of money and discounts future cost amounts to the value they would have in the present. Future costs are based on current costs grown at the rate of inflation. In general, the long-term nature of these rule and the rapidly evolving field of watershed restoration combine to make projection of costs more than a few years into the future increasingly speculative. The costs as estimated in this document represent conservative high-end estimates based on current available information and technology.

Table II below provides a summary of estimated compliance costs by affected party. Detailed costs are provided in the individual chapters. While the most current information and accounting methods were used to generate these estimates, cost projections ten years and further into the future involve a considerable amount of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below. An overview of uncertainties associated with cost estimates is provided at the end of this chapter. Each individual rule chapter also contains a more detailed discussion of uncertainties associated with that rule's costs.

Summary

Table II. Aggregated Summary of Costs to Affected Parties for All Rules

Year	Private	Local Gov't (Actual)	Local Gov't (Opportunity)	State Gov't (Actual)	State Gov't (Opportunity)	Fed Gov't	Fed Gov't (Opportunity)	Total
2011	<$ -	<$ 29m	<$ 20k	<$ -	<$ 700k	<$ -	<$ 60k	<$ 29.8m
2012	<$ 15.2m	<$ 34.2m	<$ 20k	<$ 500k	<$ 100k	<$ 10k	<$ 60k	<$ 50.1m
2013	<$ 15.8m	<$ 35.1m	<$ 20k	<$ 900k	<$ 300k	<$ 10k	<$ 70k	<$ 52.2m
2014	<$ 17.9m	<$ 46.5m	<$ 430k	<$ 3.0m	<$ 400k	<$ 30k	<$ 620k	<$ 68.9m
2015	< $ 18.6m	< $ 47.6	<$ 440k	<$ 3.2m	<$ 400k	<$ 30k	<$ 630k	<$ 71.0m
2016	<$17.8m	<$ 35.3m	<$ 440k	<$ 2.4m	<$ 400k	<$ 30k	<$ 610k	<$ 57.0m
2017	<$18.6m	<$ 36.3m	<$ 450k	<$ 2.5m	<$ 400k	<$ 30k	<$ 620k	<$ 58.9m
2018	<$19.3m	<$ 37.1m	<$ 460k	<$ 2.6m	<$ 400k	<$ 30k	<$ 630k	<$ 60.6m
2019	< $20.1m	<$ 130.6m	<$ 470k	<$ 2.7m	<$ 400k	<$ 30k	<$ 640k	<$ 154.9m
2020	<$20.9m	<$ 352.1m	<$ 470k	<$ 2.8m	<$ 400k	<$ 30k	<$ 650k	<$ 377.4m

< - Estimates are considered high-end values based on conservative assumptions for major cost elements.

Projection of costs for points 10 years and further into the future involves a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.

NPV Stg I	**<$ 109.3m**	**<$ 472.8m**	**<$ 2.0m**	**<$ 14.5m**	**<$ 2.6m**	**<$ 200k**	**<$ 2.9m**	**<$ 604.3m**
NPV Stg II	**<$ 126.7m**	**<$ 781.7m**	**<$ 2.5m**	**<$ 29.2m**	**<$ 3.8m**	**<$ 400k**	**<$ 1.5m**	**<$ 945.8m**
NPV Stg I+II	**<$ 236.0m**	**<$ 1.25b**	**<$ 4.5m**	**<$ 43.7m**	**<$ 4.3m**	**<$ 500k**	**<$ 4.4m**	**<$ 1.54b**

Conservative Estimate of Costs: Factors that suggest ultimate compliance costs lower than those projected here include: technological innovation driven by an increasing need for water conservation, innovation driven by the rules themselves; improved accounting for known measures; and general advances in management of the impacts of developed lands and of nutrients at the federal level and nationwide. We note that a Scientific Advisory Board required under the Jordan nutrient strategy will be addressing these issues and developing credit and accounting options during the next two years and beyond. We believe that our projections err on the conservative side given that we relied on the use of current technology while the ultimate catalog of creditable reduction practices will likely include more cost-effective measures and management practices resulting from innovation and technological advancement as implementation progresses over the next twenty five years. A Scientific Advisory Board required under the Jordan nutrient strategy will be addressing these issues and developing credit and accounting options during the next two years and beyond. In addition, as water quality is evaluated based on implementation of Stage I requirements, possible future changes to the nutrient management strategy and rules could introduce even more uncertainty.

Stage I Costs: We estimate total combined costs for implementation of Stage I requirements at less than $605 million. This cost estimate represents the high end cost range for Stage I. The net present value of Stage I costs for individual rules ranges from less than $6 million for Agriculture to $249 million for Wastewater Treatment.

Stage II Costs*:* We estimated compliance with Stage II reduction objectives to result in costs totaling less than $946 million. It is important to recognize that projecting plausible measures of costs and benefits that span almost three decades into the future involves an expanding set of uncertainties. Costs for timeframes further into the future must be viewed with that understanding.

Methods: In estimating costs, staff with the Nonpoint Source Planning Unit obtained input from each of the primary agencies that would be involved in implementation: local governments, university technical experts, published and unpublished data sources, and frequently relied on experience gained and tools developed in implementing similar rules in the Neuse and Tar-Pamlico River Basins and the Jordan Watershed.

Summary

One source of data for this evaluation was the Falls watershed model, mentioned under 'Sources of Nutrient Loading' above, which was developed by the Division to support the rulemaking process. The watershed model includes acreages for all land cover types and estimates of baseline loading from each land cover type to the reservoir. This analysis also benefited from the availability of several tools developed specifically for implementing Neuse and Tar-Pamlico rules or that were prompted by the imposition of those rules. Two Tar-Pamlico implementation tools used here include a stormwater loading estimation tool developed by NCSU and pasture load estimation methods and data. We also used nutrient removal efficiency values specific to piedmont North Carolina for agricultural and urban stormwater BMPs that were largely formalized for implementation of those rules and cost information for both stormwater and agricultural BMPs in piedmont North Carolina that was largely developed since 1997.

In terms of our geographic approach, to avoid undue calculation complexity we carried out calculations at the scale of the upper and lower watershed as show in Figure 1 above. We frequently used data specific to counties, municipalities, land use types, discharger types, and subwatersheds, developing weighted averages as appropriate.

Individual Rule Cost Summaries

Six of the nine proposed rules would involve costs which are summarized below. The three remaining rules (Goals, Offset Options, Definitions) and the two rule amendments (Neuse Stormwater, Neuse Basin Classification Schedule) are administrative in nature and are do not themselves impose specific requirements that result in costs to affected parties. These rules briefly summarized below and are described in more detail in Chapters 2 through 7 of this report.

.0277 Stormwater Management for New Development Costs

Developers face significant costs under this rule driven by the rule's stringent nutrient loading rate targets, which reflect the strategy reduction goals of 40% and 77% reduction in N and P loading respectively. Our most-likely estimate of watershed-wide annual costs to developers begins at approximately $5 million/yr. A high-end estimate would begin at approximately $10 million/yr. Costs are also higher than they might be to meet the goals because of the requirement to achieve a minimum 50% reduction in loading onsite as opposed to allow a larger amount of potentially more cost-effective offsite reductions. Onsite cost for county residential development is expected to be only minimally higher than under current regulations, while municipal residential and more so commercial/industrial development would be expected to see larger cost increases for onsite control. Staff considers this level of austerity reasonable and recognize that other sources, such as agriculture which otherwise could sell reduction credits to developers, will face similar magnitudes of reduction over time and are expected to require all available inexpensive improvements such as riparian buffer restoration at a minimum toward their needs.

Because all local governments currently administer one or more of Water Supply Watershed, NPDES Phase II, and Neuse stormwater requirements, additional local costs of implementing this rule are expected to be fairly minor at approximately $90,000/yr watershed-wide. We report in this rule's costs the DWQ staff opportunity costs for implementing the entire set of rules, which we estimated as a collective $100,000/yr for the first several years then reducing to approximately $66,000/yr collectively into the future

Summary

Table III. Summary of Costs - New Development Stormwater Rule

Year	Private						Local Gov't	State Gov't (Oppor-tunity)	Total
	Developers				Prop Owners	Private Total			
	Capital	Planning	Reg Trans	Total	O&M				
2011	0	0	0	0	0	$0	$220k	$680 k	$900k
2012	$5.2 - 9.6 m	$1.2 - $2.1 m	$.97 - $2.8 m	$7.4 - $14.6 m	$90 - $110 k	$7.4 - $14.7 m	$110 - $271 k	$100k	$7.7 - $15.2 m
2013	$5.4 - 10.0 m	$1.2 - $2.2 m	$1.0 - $2.9 m	$7.6 - $15.1 m	$180 - 210 k	$7.8 - $15.3 m	$120 – $281 k	$110k	$8.0 - $15.9 m
2014	$5.6 - 10.4 m	$1.3 - $2.3 m	$1.04 - $3.0 m	$7.9 - $15.7 m	$270 - 330 k	$8.2 - $16.0 m	$120 – $291k	$110k	$8.4 - $16.6 m
2015	$5.8 - 10.7 m	$1.3 - $2.4 m	$1.08 - $3.2 m	$8.2 - $16.3 m	$370 - 450 k	$8.6 - $16.7 m	$130 – $302 k	$110k	$8.8 - $17.3 m
2016	$6.0 - $11.1 m	$1.4 – $2.5 m	$1.12 - $3.3 m	$8.5 - $16.9 m	$470 - 570 k	$9.0 - $17.4 m	$130 – $320 k	$110k	$9.2 - $18.0 m
2017	$6.2 - $11.5 m	$1.4 - $2.6 m	$1.16 - $3.4 m	$8.8 - $17.5 m	$580 - $690 k	$9.4 - $18.2 m	$130 - $330 k	$80k	$9.6 - $18.8 m
2018	$6.5 - $12.0 m	$1.5 - $2.7 m	$1.20 - $3.5 m	$9.2 - $18.1 m	$690 - $820 k	$9.9 - $18.9 m	$140 - $340 k	$80k	$10.1 - $19.6 m
2019	$6.7 - $12.4 m	$1.5 - $2.7 m	$1.24 - $3.6 m	$9.5 - $18.8 m	$800 - $960 k	$10.3 - $19.7 m	$140 - $350 k	$80k	$10.5 - $20.4 m
2020	$6.9 - $12.8 m	$1.6 - $2.8 m	$1.29 - $3.8 m	$9.8 - $19.4 m	$920 k - $1.1 m	$10.7 - $20.5 m	$150 - $370 k	$80k	$10.9 - $21.2 m

Projection of costs for points 10 years and further into the future involves a great deal of uncertainty. There is reason to believe that costs may ultimately be less than the values projected below.

NPV Stage I	**$36.2 - $66.9 m**	**$8.3 - $14.9 m**	**$6.7 - $19.6 m**	**$51.2 – $101 m**	**$2.7 - $3.2 m**	**$54.0 - $105 m**	**$990k - $2.1 m**	**$1.2 m**	**$56.1 - $109 m**
NPV Stage II	**$40.8 - $75.5 m**	**$9.4 - $16.8 m**	**$7.6 - $22.1 m**	**$57.8 - $114 m**	**$8.7 - $10.4 m**	**$66.5 - $125 m**	**$850k - $2.2 m**	**$400k**	**$67.7 - $129 m**
NPV Stage I+II	**$77.0 - $142 m**	**$17.7 - $31.6 m**	**$14.3 - $41.7 m**	**$109 - $216 m**	**$11.4 - $13.6 m**	**$120 - $229 m**	**$1.80 - $4.3 m**	**$1.60 m**	**$124 - $238 m**

.0278 Stormwater Management for Existing Development Costs

As illustrated in the summary cost tables, this rule and the wastewater rule will clearly impose the most significant costs of the strategy on local governments. While less uncertainty surrounds costs for the initial years of implementation, it is likely that more cost-effective measures than structural stormwater BMP retrofits will emerge even during the course of Stage I. More cost-effective load-reducing options are in various stages of development and quantification, but none were sufficiently well-developed to allow their use for these purposes. We consider our use of BMP retrofits to provide conservative or high-end estimates.

We estimated a total 10-year, Stage I cost of approximately $225 million watershed-wide, in net present value terms, making annual costs less than $22 million assuming a constant rate of implementation beginning in year one. Stage II estimates based on the same high-end BMP retrofit assumptions are approximately $51 million/yr or a total of approximately $776 million watershed-wide, in net present value terms, to meet the full reduction. A number of drivers, including the growing need for water conservation, the costs of conventional retrofit approaches under this rule, and the growing field of alternative options are expected to result in ultimate compliance costs significantly lower than these projections suggest.

Summary

Table IV. Summary of Costs - Existing Development Stormwater Rule

Year	Private	Local Government				State Gov't	Fed Gov't	Total
		Planning	Capital	O&M	Total			
2011	$ -	< $ 6.4 m	< $ 22.1 m	< $ 190 k	< $ 28.8 m	$ -	$ -	< $ 28.8 m
2012	$ -	< $ 6.6 m	< $ 22.6 m	< $ 390 k	< $ 29.6 m	$ -	$ -	< $ 29.6 m
2013	$ -	< $ 6.7 m	< $ 23.1 m	< $ 600 k	< $ 30.4 m	$ -	$ -	< $30.4 m
2014	$ -	< $ 6.8 m	< $ 23.6 m	< $ 820 k	< $ 31.2 m	$ -	$ -	< $ 31.2 m
2015	$ -	< $ 7.0 m	< $ 24.0 m	< $ 1.0 m	< $ 32.0 m	$ -	$ -	< $ 32.0 m
2016	$ -	< $ 7.1 m	< $ 24.5 m	< $ 1.3 m	< $ 32.9 m	$ -	$ -	< $ 32.9 m
2017	$ -	< $ 7.3 m	< $ 25.0 m	< $ 1.5 m	< $ 33.8 m	$ -	$ -	< $ 33.8 m
2018	$ -	< $ 7.4 m	< $ 25.5 m	< $ 1.8 m	< $ 34.6 m	$ -	$ -	< $ 34.6 m
2019	$ -	< $ 7.5 m	< $ 25.9 m	< $ 2.0 m	< $ 35.5 m	$ -	$ -	< $ 35.5 m
2020	$ -	< $ 7.6 m	< $ 26.4 m	< $ 2.3 m	< $ 36.3 m	$ -	$ -	< $ 36.3 m

Projection of costs for points 10 years and further into the future involves a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.

NPV Stg I	**$ -**	**< $ 48.9 m**	**< $ 169 m**	**< $ 7.5 m**	**< $ 225 m**	**$ -**	**$ -**	**< $ 225 m**
NPV Stg II	**$ -**	**< $112 m**	**< $ 403 m**	**< $35.8 m**	**< $ 551 m**	**$ -**	**$ -**	**< $ 551 m**
NPV Stg I+II	**$ -**	**< $161 m**	**< $ 571 m**	**< $43.3 m**	**< $ 776 m**	**$ -**	**$ -**	**< $ 776 m**

.0279 Wastewater Discharge Costs

Cost estimates were developed using a variety of methods and sources of information. Estimates for implementation of conventional BNR technologies are based on methods and estimates developed for the Chesapeake Bay nutrient program. Those for advanced treatment are based on reference information for the wastewater industry.

Cost estimates for Stage 1 improvements are based on upgrading from existing treatment capability to full conventional BNR by 2016 and additional capital improvements through 2020. Planning and design is scheduled for 2012-13 with construction to follow in 2014-2015. We estimated a total 5-year net present value of Stage I cost of approximately $249 million watershed-wide, making annual costs approximately $25 million assuming a constant rate of implementation beginning in year one.

Stage II estimates based on the assumption that flows will steadily increase from current levels (50% of permitted flows) to full permitted flows by 2031 and that membrane filtration and reverse osmosis units will be added incrementally over that time: 20% of permitted capacity in 2020, another 30% in 2025, and the final 50% in 2030. The net present value of Stage II cost of approximately $229 million watershed-wide to meet the full reduction requirements.

Summary

Table V. Summary of Estimated Costs For Total Nitrogen and Total Phosphorus Reductions - Wastewater Discharge Requirements[1,2]

	Private				Local Government				State Government	Federal Government	Total (Millions $)
Year	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**			
2011	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
2012	$ 0.49	$ 0	$ 0	$ 0.49	$ 4.32	$ 0	$ 0	$ 4.32	$ 0	$ 0	$ 4.81
2013	$ 0.50	$ 0	$ 0	$ 0.50	$ 4.41	$ 0	$ 0	$ 4.41	$ 0	$ 0	$ 4.91
2014	$ 0	$ 1.68	$ 0	$ 1.68	$ 0	$ 15.00	$ 0	$ 15.00	$ 0	$ 0	$ 16.68
2015	$ 0	$ 1.72	$ 0	$ 1.72	$ 0	$ 15.29	$ 0	$ 15.29	$ 0	$ 0	$ 17.01
2016	$ 0	$ 0	$ 0.10	$ 0.10	$ 0	$ 0	$ 2.14	$ 2.14	$ 0	$ 0	$ 2.24
2017	$ 0	$ 0	$ 0.10	$ 0.10	$ 0	$ 0	$ 2.18	$ 2.18	$ 0	$ 0	$ 2.28
2018	$ 0	$ 0	$ 0.10	$ 0.10	$ 0	$ 0	$ 2.22	$ 2.22	$ 0	$ 0	$ 2.32
2019	$ 0	$ 0	$ 0.10	$ 0.10	$ 92.37	$ 0	$ 2.26	$ <94.63	$ 0	$ 0	$ <94.73
2020	$ 0	$ 0	$ 0.10	$ 0.10	$ 0	$ <313.13	$ 2.30	$ <315.43	$ 0	$ 0	$ <315.53

Projections of costs for advance treatment technologies and for points 10 years and further into the future involve a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.

Stage 1 NPV[3]	$ 0.83	$ 2.51	$ 0.29	$ 3.63	$ 57.62	$ <181.53	$ 6.47	$ <245.62	$ 0	$ 0	$ <249.25
Stage 2 NPV[4]	$ 0	$ 0	$ 0.54	$ 0.54	$ 33.81	$ <107.29	$ 87.81	$ <228.91	$ 0	$ 0	$ <229.45
Total NPV (Stages 1,2)	$ 0.83	$ 2.51	$ 0.83	$ 4.17	$ 91.43	$ <288.82	$ 94.28	$ <474.53	$ 0	$ 0	$ <478.70

Footnotes:

[1] Beyond initial BNR improvements, costs are based on an 'advanced treatment only' approach without consideration of reuse and other alternatives and are meant to approximate high-end costs for implementing the wastewater requirements rule, as conditioned in this chapter.

[2] All NPV costs are adjusted for inflation based on CPI projections (approximately 1.8% per annum), then discounted to 2010 values at a rate of 7% per annum.

[3] Stage 1 costs are those projected to occur from 2011 through 2020.

[4] Stage 2 costs are those projected to occur from 2021 through 2035.

Summary

.0280 Agriculture Costs

Cropland is currently subject to the existing Neuse Agriculture Rule, but farmers face additional costs under this rule driven by the rule's stringent nutrient loading rate targets, which reflect the strategy reduction goals of 40% and 77% reduction in N and P loading respectively. Both state and federal cost share programs are available to crop and pastureland producers. Thus, we estimated capital costs to farmers for practice installation assuming that 75% of that cost would be captured as an opportunity cost to the State and Federal government through the use of cost share funding. The costs provided are those to meet nitrogen reduction goals, since currently available accounting criteria for phosphorus are qualitative in nature.

Our estimates err on the conservative or higher side in that we met the entire reduction need by assuming structural BMPs for pasture and assumed no additional opportunity for reductions from cropland. However, there may be additional more cost-effective reduction opportunities from cropland and workgroups are currently working on developing crediting for nutrient reducing management practices for pasture that may prove more cost effective in the future. In addition to this there are some no cost actions that may result in further nutrient reductions, such as fertilizer rate reductions, crop shifts yielding further N rate reductions, and land loss from agriculture. A summary of cost to farmers for implementing the agriculture rule and opportunity costs to state and federal agencies that provide BMP subsidies is provided below. The local governments cost estimates express estimated increase in capital costs related to land application of wastewater residuals per the Agriculture rule which requires land application be done in accordance with Realistic Yield Expectation nitrogen rates and compliance with the Phosphorus Loss Assessment Tool (PLAT) or other approved phosphorus rate index.

Table VI. Summary of Costs – Agriculture Rule

Year	Private (Farmers)					Local Gov't	State	Federal	Total
	Planning	Capital	O&M	Opportunity	Total	Total	Total	Total	All Parties
2011	$0	$0	$0	$0	$0	$20k	$10K	$60k	$90k
2012	$0	$0	$0	$0	$0	$20k	$10K	$60k	$90k
2013	$0	$0	$0	$0	$0	$20k	$10K	$70k	$90k
2014	$0	$170 – 210k	$10k	$4 – $5k	$190 – $220k	$330 - $430k	$80	$520 - $620k	$1.1 - $1.3m
2015	$0	$180 – $210k	$20 -$30k	$10k	$210 – $240k	$330 - $440k	$80	$530 - $630k	$1.1 – $1.4m
2016	$0	$180 - $220k	$30 – $40k	$10 – $10k	$230 – $270k	$330 - $440k	$80	$510 - $610k	$1.1 – $1.4m
2017	$0	$180 - $220k	$40 – $50k	$20 – $20k	$240 – $290k	$340 - $450k	$80	$520 - $620k	$1.2 – $1.4m
2018	$0	$190 -$220k	$60 – $70k	$20 -$20k	$260 – $310k	$350 - $460k	$80	$530 - $630k	$1.2 – $1.5m
2019	$0	$190 -$230k	$70 – $80k	$30 – $30k	$280 – $340k	$350 - $470k	$80	$540 - $640k	$1.3 – $1.5m
2020	$0	$190 - $230k	$80 -$100k	$30 – $30k	$300 – $360k	$360 - $470k	$80	$540 - $640kk	$1.3 – $1.6m
Projection of costs for points 10 years and further into the future involves a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.									
Stage I Inflated NPV	$0	$.81 – $1.0m	$180 – $220k	$70 -$80k	$1.1 – $1.2m	$1.5 – 2.0m	$370	$2.5 - $2.9m	$5.4 – $6.6m
Stage II Inflated NPV	$0	$470 – $560k	$630 -$740k	$310 – $360k	$1.4 – $1.7m	$1.5 – 2.5m	$420	$1.2 - $1.5m	$4.5 – $6.1
Total Inflated NPV (I+II)	$0	$1.3 – $1.5m	$.80 – $1.0m	$400k	$2.5 - $2.9m	$3.0 – 4.5m	$790k	$3.7 - $4.4m	$9.9-$12.6m

Summary

.0281 Stormwater Requirements for State and Federal Entities Costs

Provisions of the new and existing development stormwater rules, .0277 and .0278, are applied to state and federal entities, primarily the NC Department of Transportation (DOT), and other state and federally owned lands in the watershed. The Division would function as implementing agency. These parties would be required to achieve nutrient loading reductions in stormwater runoff from existing developed lands under their control toward the strategy percentage goals. They would also be required to obtain permits from the Division for new development, demonstrating that stormwater discharges from development projects would achieve export rate targets equating to the strategy percentage goals.

The cost estimates provided for DOT, federal and Non-DOT state lands likely represent an overestimation of actual costs. We suspect that the character of new development in the form of land consumption may vary substantially among them. Additionally, much of the state and federal land in the watershed is recreational, cultural, or historic in nature, all of which we would expect to load nutrients at very low levels or related to agriculture research which would be covered under the agriculture rule. A summary of the combined costs for State and Federal entities is provided below.

Table VII. Summary of Costs – State & Federal Entities Rule

Year	State					
	Planning	Capital	O&M	Reg. TC	Opportunity	Total
2011	$0	$0	$0	$0	$0	$0
2012	$40 - $80k	$200 – $400k	$0	$40 -$100k	$0	$270 - $540k
2013	$370 - $410k	$200 – $400k	$10k	$40 -$100k	$0	$610 -$890k
2014	$370 – $410k	$1.5 -$1.7m	$70k	$40 -$100k	$0	$2.0- $2.2m
2015	$370 - $410k	$1.5 -$1.7m	$80k	$40 -$110k	$0	$2.0 - $2.3m
2016	$380 - $420k	$1.5 – $1.7m	$80k	$40 - $110k	$0	$1.5 – $1.8m
2017	$380 - $420k	$1.5 – $1.7m	$80 - $90k	$40 - $120k	$0	$1.6 – $1.9m
2018	$380 - $420k	$1.5 – $1.7m	$90k	$50 - $120k	$0	$1.6 – $2.0m
2019	$380 – $430k	$1.5 -$1.7m	$90 - $100k	$50 -$120k	$0	$1.7 – $2.0m
2020	$380 - $430k	$1.5 – $1.7m	$100k	$50 - $130k	$0	$1.7 – $2.1m
Projections of costs for advance treatment technologies and for points 10 years and further into the future involve a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.						
Stage I NPV	$2. – 2.2m	$7.0 - $8.1m	$380 - $390k	$250 - $700k	$0	$9.6 -$11.4m
Stage II NPV	$4.5 - $4.7m	$16.3 – $17.7m	$160 - $170k	$280 -$800k	$0	$22.7 - $24.9m
Stage I+ II NPV	$6.5 – $7.0m	$23.3 – $25.7m	$2.0 – $2.1m	$0.5 – $1.5m	$0	$32.3 - $36.4m

Table VII *(Continued)*. Summary of Costs – State & Federal Entities Rule

Year	Federal					
	Planning	Capital	O&M	Reg. TC	Opportunity	Total
2011	$0k	$0k	$0k	$0k	$0	$0k
2012	$1k	$3 - $5k	$0k	$1k	$0	$4 - 8k
2013	$5 - $6k	$3 - $5k	$0k	$1k	$0	$9 - $13k
2014	$5 - $6k	$21 - $23k	$1k	$1k	$0	$28 - $32k
2015	$5 - $6k	$21 - $24k	$1k	$1 – $2k	$0	$28 - $32k
2016	$5 - $6k	$21 - $24k	$1k	$1 – $2k	$0	$22 - $26k
2017	$5 - $6k	$21 - $24k	$1 - 2k	$1 – $2k	$0	$22 -$ 27k
2018	$5 - $6k	$21 - $24k	$1k	$1 – $2k	$0	$23 - $28k
2019	$5 - $6k	$21 - $24k	$2k	$1 – $2k	$0	$24 - $28k
2020	$5 - $6k	$22 - $25k	$2k	$1 – $2k	$0	$24 - $30k
Projections of costs for advance treatment technologies and for points 10 years and further into the future involve a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.						
Stage I NPV	$30k	$100 - $114k	$6k	$4 - $10k	$0	$140 - $160k
Stage II NPV	$60 - $67k	$230 - $250k	$24k	$4 - $12k	$0	$320 - $350k
Stage I + II NPV	$90 -$99k	$330 - $360k	$30k	$7 - $22k	$0	$470 - $510k

Year	NCDOT					
	Planning	Capital	O&M	Reg. TC	Opportunity	Total
2011	$0	$0	$0	$0	$0	$0
2012	$0	$0	$0	$0	$0	$0
2013	$0	$0	$0	$0	$74 – $220k	$74 - $220k
2014	$0	$480 - $710k	$3 - $4k	$0	$76 - $230k	$560 - $940k
2015	$0	$620 - $910k	$7 - $9k	$0	$77 – $230k	$.70 - $1.1m
2016	$0	$380 - $920k	$21 – $26k	$0	79 - 240	$.48 – 1.2m
2017	$0	$390 - $930k	$25 – $31k	$0	81 - 240	$.49 – 1.2m
2018	$0	$390 - $940k	$58 – $95k	$0	82 - 250	$.53 – 1.3m
2019	$0	$400 - $950k	$62 – $101k	$0	83 - 250	$.54 – 1.4m
2020	$0	$400 - $960k	$67 – $108k	$0	85 - 250	$.56 – 1.3m
Projections of costs for advance treatment technologies and for points 10 years and further into the future involve a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.						
Stage I NPV	$0	$2.0 – $2.9m	$140 - $210k	$0	$400k – $1.2m	$2.5 - $4.3m
Stage II NPV	$0	$2.1 – $3.1m	$700k – $1.2m	$0	$400k – $1.3m	$3.3 – $5.6m
Stage I + II NPV	$0	$4.1 – $6.0m	$800k – $1.4m	$0	$850k – $2.6m	$5.8 – $10.0m

.0283 Fertilizer Management Costs

We estimate minimal new costs associated with this rule based on experience in the Neuse and Tar-Pamlico River Basins. The rule offers a no-cost option in NM training, and we believe that only those who *already* meet the other option, implementing a certified plan, would choose that alternative instead. Training would involve no out-of-pocket costs to applicators since local Cooperative Extension Service offices would conduct trainings, they would charge no fee, would use existing staff resources, would obtain grant funding as was done in the Neuse and Tar-Pamlico Basins to cover the minimal costs, attendees would travel minimal distance since it would be offered in each county, and we assume they would incur no significant travel costs. Trainees would face lost income for the one day they take to complete the training, and we estimate the total lost income as $2,350. We also estimate the Extension staff hours involved in providing the training and convert them to salary reflecting other duties displaced; this totals to approximately $5,300 which we consider insignificant for fiscal reporting purposes. If an applicator were to choose the certified plan option and did not already meet its requirements, we assume there would still be no net cost. While there is up-front planning cost, agricultural evaluations show that applicators are likely to realize net *savings* by obtaining and properly implementing certified nutrient management plan.

Summary of Benefits

In addition to providing estimated costs of rule compliance, this document also provides a discussion of the benefits of resulting from implementation of the proposed rules. Benefits are not as readily estimated in monetary terms as are costs. Many benefits are "non-market" in nature and are thus more difficult to monetize. In this section we identify a number of benefits we believe are associated with successful implementation of the strategy, and assign dollar values to as many as possible.

Assuming the strategy reductions are met, resulting improvements in raw water quality would help lower current drinking water treatment costs through reductions of chemical treatment needed and could also avoid potential future costs of expensive treatment upgrades. We would also expect improved conditions for primary contact recreation which include swimming, fishing, boating, and skiing. Improvement in the water quality would also likely have a positive impact on local property values in general, increasing with greater proximity to the lake, and would serve to enhance the greater local economy through increased desire to live near a healthy sustainable natural resource. A listing of potential benefits is provided in Table A below. A more detailed discussion of these benefits is provided in Chapter 1.

Table VIII. Potential Benefits of the Falls Nutrient Strategy[1]

Benefit Types	***Estimated Strategy Benefit Value***	***Estimated Value of Falls Lake Water Supply[2]***
Avoided Drinking Water Treatment Costs	$43 million - $266 million	*
Reduced Drinking Water Treatment Costs	$600k - $800k[4]	*
Value of Falls Lake	*	$420 million - $1.1 billion[3]
Recreational Benefits	$179 million - $336 million	*
Local Economy and Property Values	*	*
Upstream Reservoir Improvements	*	*
Watershed Stream Improvements	*	*
Aquatic Life Benefits	*	*
Ecological/Food Chain Communities	*	*
Neuse Estuary Improvement	*	*

* While these benefits will occur we are unable to quantify them.
[1] Benefits were generated using various inflation & discount rates and are not directly comparable
[2] Estimated value of Falls Lake as a water supply is not additive with the strategy benefits
[3] Estimated Value of Falls Lake is in 2010 dollars – Not adjusted for Inflation / Discounted
[4] Annual Benefit – Not adjusted for Inflation / Discounted

Avoided Drinking Water Treatment Costs

While the E.M. Johnson (EMJ) Water Treatment Plant is currently very successful in cleansing Falls Lake water of TOC problems through vigilant use of existing treatment processes and aggressive flushing of the City's potable water distribution system, Raleigh's Public Utilities staff warn that increased TOC at the plant will require the implementation of more sophisticated and much more expensive treatment methods. These new, advanced treatment processes use Activated Carbon or Magnetic Ion Exchange resin and could increase operational costs by 20 to 25% annually. This upgrade to a more elaborate treatment method also would require capital construction projects that have a projected price tag of $120 million tag. The total capital and O&M costs of the different treatment upgrade options that would be needed should Falls lake water quality continue to deteriorate are

estimated to range $43 to $266 million when adjusted for inflation by 3% annually over 30 years and discounted at %5 to provide net present value in 2010 dollars (City of Raleigh 2009).

Reduced Drinking Water Treatment Costs

Assuming the strategy reductions are met, then improvements in raw water quality can also help lower current drinking water treatment costs through the reduction of chemical treatment needed and help avoid the costs of expensive treatment upgrades in future. Based on evaluation of potential treatment options at Raleigh's EM Johnson drinking water facility, the total capital and O&M costs of the different treatment upgrade options that would be needed should Falls lake water quality continue to deteriorate are estimated to range $43 to $266 million when adjusted for inflation by 3% annually over 30 years and discounted at 5% to provide net present value in 2010 dollars. Improvement in the lake water quality is also expected to reduce the amount of chemical treatment needed and result in the current annual treatment costs to be reduced by approximately $600K on an annual basis.

Value of Falls Lake as a Drinking Water Supply

In Chapter 1 we provide an estimated range for the value of Falls Lake as a drinking water supply which attempts to quantify the value of Falls Lake as a clean and reliable source of drinking water. The value of the lake was calculated by estimating assumed replacement costs using other viable alternative drinking water sources. The high range estimate is based on calculations provided by the City of Raleigh based on their assessment of available alternative sources of drinking water including Kerr Lake, PCS Phosphate dewater, and the Atlantic Ocean. Kerr Lake has was determined to represent the most likely estimated value of Falls Lake for this analysis based on its available volume for water supply. The low-end estimated value of the lake is based on cost information from the Lake Gaston Water Supply project in Virginia Beach, VA. The value of Falls Lake as a drinking water supply is estimated to be within the range of $420 million and $1.1 billion.

Recreational Benefits

DWQ collaborated with researchers at NCSU to obtain estimated benefits of the recreation use of Falls Lake. The recreation benefits are based on the core assumption that an overall increase in lake user-days can be correlated with improved water quality (Egan 2004). Additional benefits include a correlated increase in related recreation such as camping, hiking, and wildlife viewing. A cleaned-up water body will be more attractive to recreators and therefore generate more intensive use and benefits to society (von Haefen 2010). The results from the sensitivity analysis from this study suggest that the benefits for North Carolina residents from the watershed-wide Falls Lake nutrient management strategy will be between $179 million to $336 million in net present value dollars when taking into account inflation over the next 30 years and assuming a 7% discount rate.

Local Property Value Benefits

Land prices are usually higher for land parcels close to lakes because of the views and boating or fishing opportunities (Kramer 2005). The greater desire to locate housing and businesses near the lake, benefit a productive economy (NCDWQ 2007).

Local Economy Benefits

Similar to the benefits to local property values, improved water quality resulting in an increased desire to live in proximity to a healthy natural resource would be expected to have a positive impact on the local economy within the watershed.

Water Storage Benefits

There are several benefits regarding upstream public water supply reservoirs located in the Falls Lake watershed. Since the proposed nutrient management strategy targets nonpoint sources of pollution or stormwater runoff, sedimentation (or the "filling in" of sediment) to the smaller upstream water supply reservoirs would occur more slowly. This could reduce the need for potential future dredge projects to restore volume capacity. Costs associated with developing a future water supply reservoir could be avoided by utilizing these existing reservoirs. In addition, future nutrient reduction costs may be prevented for these existing reservoirs (upstream of Falls Lake).

Aquatic Life Benefits

Reduced occurrences of algal blooms and sediment contributions due to lower nutrient loading in the watershed would assist in meeting the water quality standard for turbidity and chlorophyll-*a*. In addition, the reduction in nutrient inputs will improve the aquatic environment with healthier dissolved oxygen and pH levels.

Neuse Estuary Improvement Benefits

Assuming these reductions are met, less nutrient loading is expected to leave Falls Lake at the Dam. Less loading coming from Falls Lake will help downstream affected parties who are mandated to reduce nutrient loading in the Neuse River Basin under the Nutrient Sensitive Waters (NSW) Management Strategy.

Uncertainty and Alternatives

Uncertainty

The cost estimates calculated for implementation of each rule were developed using the most recent research and best available data and accounting tools. However numerous assumptions and estimates are necessary to project long range costs of implementation. Chapters 2 through 7 include detailed explanations of the assumptions used and provide discussion of the uncertainties related to the cost estimates calculated for the corresponding rules. In general, the long-term nature of these rule and the rapidly evolving field of watershed restoration combine to make projection of costs more than a few years into the future increasingly speculative. The costs as estimated in this document represent conservative high range estimates based on current available information and technology.

The nutrient reductions needed for Falls Lake to meet it water quality goals are substantial. It is likely that these rules and the large load reductions needed will drive innovation in technology and techniques resulting in more cost-effective means of achieving the necessary reductions. A number of drivers, including the growing need for water conservation, the costs of conventional engineered best management practices, the growing field of alternative options and ongoing research to refine and update credit accounting to capture innovative practices are all expected to result in ultimate compliance costs significantly lower than the projections provided in this analysis suggest.

In addition to the uncertainty resulting from the long range nature of these rules and future innovations in more cost-effective technology, the rules themselves are designed using an adaptive management approach which introduces additional uncertainty in cost to implement. Goals rule provides for an adaptive management approach which may result in changes in the required reductions as implementation continues into the future. The Rule includes language allowing for submittal of a supplemental model for EMC approval. Based on future approved monitoring and modeling, the Commission could consider revisions to the requirements of Stage II. The Goals Rule also enables the Commission to establish revised nutrient allocations based on the outcome of an approved supplemental model. The rule works to further address uncertainty in implementation by requiring DWQ to report to the EMC and public in 2016 and every five years thereafter on a host of items that will inform future implementation including the following:

- The state of wastewater and stormwater nitrogen and phosphorus control technology
- Reuse an projected reuse of wastewater and land application opportunities
- The utilization and nature of nutrient offsets and projected changes
- Results of studies evaluating instream loading changes resulting from implementation of individual rules
- Assessment of instream benefits of local programmatic management measures
- Results of applicable studies, monitoring, modeling and establish a baseline for atmospheric nitrogen deposition
- Projected reductions in atmospheric deposition based on current modeling
- Results of studies evaluating nutrient loading from groundwater
- Updates to nutrient loading accounting tools
- Evaluation of available nutrient-related lake monitoring data; and
- Recommendations if any on rule revisions

Other factors relative to the individual rules that lead us to believe that technological innovation, refinements in accounting and new research will lead to additional management measures that will likely prove more cost-effective include such things as the following

- New accounting tools being developed for stormwater management that can provide reduction credit for management measures with benefits that were previously unquantified;

- Workgroups working on developing credit accounting for pasture practices to achieve additional reductions from Agriculture;
- Ongoing research of the loading contribution for onsite waste water systems. Reductions from onsite systems as yet unquantified may be a cost effective means of achieving nutrient reductions from existing development. The affected and contributions to overall reduction needs from other non-structural practices such as pet waste and fertilizer ordinances cannot yet be quantified;
- Re-use may prove to play an increased role as a more cost effective means of achieving reductions from point sources; and
- Ongoing reductions from atmospheric sources of nitrogen as a result of stricter emission standards for both mobile and immobile sources.

A Scientific Advisory Board required under the Jordan nutrient strategy will be addressing these issues and developing credit and accounting options during the next two years and beyond. In addition to structural retrofits, which are also evolving to be more effective, practices that local governments will likely be able to take increasing advantage of in the future may include:

Programmatic:

- Requiring treatment on redevelopment,
- Pet waste regulation,
- Fertilizer application regulation,
- Improved street sweeping,
- Retrofitting existing stormwater quantity ponds,
- Off-line regional treatment facilities,
- Small-scale property owner practices, e.g. redirecting impervious surfaces,

Wastewater:

- Removing onsite sand filter discharges,
- Correcting malfunctioning septic systems
- Improvement of wastewater collection systems,
- Eliminating illicit discharges,

Ecosystem Restoration:

- Stream, wetland and riparian buffer restoration, and
- Purchase and reforestation of agricultural land.

Alternatives to the Strategy

The Environmental Management Commission is charged, under NC statutes Chapter 143B-282, with responsibility for restoring and protecting water quality statewide, and is given authority to adopt rules to that end. More recently, the sweeping Clean Water Responsibility Act of 1997, S.L. 1997-458, included requirements to address water quality problems in Nutrient Sensitive Waters. Often referred to as House Bill 515, the act directed the Commission to establish goals for reducing nutrient inputs to these waters, to ensure that point and nonpoint sources share proportionally in responsibility for reducing inputs. S.L. 250 - 190, also known as Senate Bill 981 directs the EMC to adopt a nutrient management strategy for Falls Lake and for that strategy to be based on a calibrated nutrient response model.

A stakeholder process conducted through a joint effort between the Triangle J Council of Governments (TJCOG) and DWQ between August 2008 and January 21, 2010 to provide stakeholders an opportunity for input on development of a nutrient strategy for the lake. Throughout the extensive process DWQ received input from concerned stakeholders on developing the strategy which included discussions of possible alternative management measures.

Summary

Alternatives for specific rules are covered in the individual rule chapters of this document. The following is a brief discussion of alternatives to implementing a strategy itself. DWQ held nine stakeholder meetings and twelve smaller subcommittee meetings over a period of seventeen months to discuss and receive input on the strategy development from affected parties. During the course of these meetings various options and alternatives were discussed with stakeholders. Some of the options discussed, like using allocations instead of concentration limits in Stage I of the Wastewater Rule and including a Low Impact Development option in the New Development Stormwater Rule were incorporated into the draft rules that are scheduled to go out to public hearing in summer 2010.

While alternatives to implementing a strategy where discussed, ultimately none of the alternatives were considered viable options. In large part the alternatives discussed were not in agreement with the charge of the EMC and DWQ and would at best only result in limited water quality improvement in localized areas. Some not address water quality improvement throughout the lake or their implementation was outside the authority of DWQ and DENR and required action from federal agencies outside the charge of the Division of Water Quality and the Environmental Management Commission. An overview of the major alternatives brought up during the stakeholder process is provided below:

Removal the Dam

Some stakeholders suggested that the water quality problems in the lake would not exist if the Dam was not built and the Neuse River was allowed to flow unobstructed by the impoundment. This is an extreme case alternative to implementing a management strategy that was raised early on in the stakeholder process. However in light of the lakes obvious large scale benefits, such as serving as the primary drinking water supply for roughly 450,000 residents in Wake County, providing flood control, and recreational benefits, and the fact that this alternative does not agree with the charge of the EMC this alternative was not deemed a viable alternative strategy early on in the process.

Dredge the Lake

Dredging of the nutrient-rich upper sediment layers is another alternative to the strategy that was discussed. Lake bottom sediment in Falls Lake does contribute to the nutrient load to the lake through internal loading. However, removal of this source alone would not result in water quality standards being met throughout the lake. It would need to be performed in concert with an overall strategy addressing external sources of nutrient loading. Dredging would be a labor intensive operation with considerable costs and provide logistical problems related to disposal of dredging spoils. Again, given the fact that this approach would not completely alleviate the need for a management strategy and the fact that such activity is outside the authority of DWQ and the EMC it was not found to be a viable alternative.

Remove Road Crossing and impoundments

Another alternative raised during the stakeholder process was the idea of removing or modifying the road crossing of the various highways and roads that cross the lake. The idea being that the causeways for such road crossing created small impoundments within the lake restricting the flow or water resulting in water quality problems. However, given that there are chlorophyll-a violations throughout the lake and not just in areas adjacent to road crossings and the fact that removing these causeways would at best likely only result in localized improvements, such an approach would sufficiently address the water quality problems throughout the lake.

Lake Pool Management

On alternative that may prove to play a role in the overall strategy in the future is the concept of "pool management". The thinking behind this being that by managing the lake pool levels it would be possible to improve water quality by potentially limiting inputs from vegetative growth that emerges in the exposed dry lake beds during dry months and later serves a source of nutrients as it dies off. While this is an intriguing approach there is no scientific evidence that water quality standards could be met throughout the lake through pool management alone. This is emphasized by the fact that the lake has experienced high Chl-a levels in both wet and dry years. Ultimately, control of pool levels and dam activity is outside the authority of DWQ and the EMC. Local governments may pursue other federal agencies and explore how they could potentially incorporate a regional approach such as this as a complimentary component to the implementation of the larger nutrient reduction strategy, but currently pool level management is not viewed as a viable alternative to the management strategy.

While alternatives to implementing a strategy could not be pursued, the stakeholder did have the opportunity to provide valuable input on strategy implementation including input proportions of the reduction objectives and the geographic distribution of those objectives in addition to various options for implementation that were ultimately incorporated into the strategy. A brief overview is provided below:

Dual reductions, reductions in both nitrogen and phosphorous loading, are needed for Falls Lake. DWQ staff presented and received input from stakeholders on various potential nitrogen and phosphorus percent reduction combinations. These dual reduction combinations were developed using the calibrated nutrient response model. Ultimately the stakeholders provided input that favored a reduction combination calling for a larger portion of phosphorus reductions and a smaller nitrogen reduction (30% TN and 77% TP). Reasons given were that such a combination recognizes that agriculture and point sources have already achieved significant reductions in nitrogen loading under the existing Neuse nutrient management strategy in addition to the fact that reducing phosphorus loads is more cost effective for certain sources.

Fiscal Note Format

The format of the fiscal note is based on software created through a cooperative agreement between the University of North Carolina, Chapel Hill and DENR. This software provides a series of questions about the proposed rule organized into six steps as follows:

Step 1: Description of the Proposed Rule
Step 2: Screening Analysis: Exemptions, Prima Facie Determinations and Emergency Rules
Step 3: Defining the Problem and the Regulation
Step 4: Identify Impacts
- **4-A.** Regulated Parties
- **4-B.** Implementing Agency
- **4-C.** Public Beneficiary

Step 5: Threshold Decision After Preliminary Rule Evaluation
Step 6: Analysis for Major Rules

Step 1: Description of the Proposed Rule contains basic information about the proposed rule and identifies the analyst.

Step 2: Screening Analysis: Exemptions, Prima Facie Determinations, and Emergency Rules includes a number of questions that aid in determining whether or not it is necessary to perform a fiscal analysis. For all of the proposed rules, the answers are provided in Table 15.

Table VIII. Screening Analysis

Circumstances	Yes or No
2.1 Federal Rule Certification Required. Does the proposed rule require a federal certification statement under NCGS 150B-21(f1)?	No.
2.2 "Substantial Economic Impact" Analysis. Federal Rule Exemption Does this rule meet the criterion of Federal Exemption found in NCGS 150B-21.4(b1)? [If the answer is yes and there is no impact on local government funds, you may prepare a Special Circumstance Report.]	No.
2.3 Temporary Rules. Does this rule meet the criteria listed in NCGS 150B-21 relating to Temporary Rules? [If the answer is yes, you may prepare a Special Circumstance Report.]	No.
2.4 Technical Corrections. Does this rule meet the criteria for a Technical Correction laid out in NCGS 150B-21.5? [If the answer is yes, you may prepare a Special Circumstance Report.]	No.
2.5 Repeal of Regulatory "Deadwood". The Help file lists a series of situations which may render a rule obsolete; does this rule meet any of those criteria? [If the answer is yes, you may prepare a Special Circumstance Report.]	No.

Step 3: Defining the Problem and the Regulation contains a more detailed description of the proposed rule and describes how it would change the behavior of the regulated community if it were implemented.

Step 4: Identifying Impacts describes the current practices of the regulated community(ies), and how these practices are contributing to environmental problems. The section contains three parts. For each part, the underlying assumptions (if applicable) and the sources of information are given.

Step 5: Uncertainties & Alternatives includes a discussion of the uncertainties that impact the cost estimates and alternatives to the rule requirements that were considered during rule development.

General:

One of the most important points of this fiscal analysis is that it is not appropriate to compare the costs of the different rules to each other. Some of the reasons why comparisons between rule costs are not valid are:

- The costs would be borne differently by different regulated parties. For example, the costs to treatment plants may be spread throughout a large customer base while farmers would have individual costs to their businesses, but may be able to defray some of their costs through funding sources such as the NC Agricultural Cost Share Funding.
- There may be some additional non-quantifiable costs and /or savings associated with particular rules, including the Basinwide Stormwater Rule.
- Many assumptions were made for each one of the rules in order to predict the behavior of the regulated parties. The assumptions required to estimate the costs could not be standardized since each rule affects different parties and regulates different issues.
- A summary of the costs to the regulated parties for each of the proposed rules follows. Please note that three of the rules, .0275, .0276 and .0282 and two rule amendments, .0235 and .0315 do not have any costs associated with them because they do not regulate behavior, they only lay the necessary framework for the

other rules.

Regulated Parties

Description of the Regulated Community	The regulated community is defined as the group of North Carolinians that must comply with the proposed rule. The regulated community may include one or more of the following: Specific Industries and Businesses, Specific Geographic Areas, Local or State Governments, Citizens, and Generic Activities (e.g., Use of solvents, tank storage of chemicals).
Fixed Capital Investment	This is the estimated cost associated with a capital investment that is made to comply with the proposed rule. Some examples of fixed capital investments associated with the Falls Reservoir watershed NSW Rules include: wastewater treatment plant modifications, stormwater best management practices (such as wet detention ponds), and the installation of water control structures.
Operation and Maintenance Cost	Operating and maintenance costs include recurring costs, such as labor and equipment that the regulated entity must obtain to comply with the proposed rule. Some examples of operation and maintenance costs associated with the Falls Reservoir watershed NSW Rules include: maintenance of additional basins at treatment plants, mowing and repair of best management practices, and updating nutrient management plans.
Planning Costs	The expense of creating plans/designs for the regulated party to comply with the proposed rule. To determine an estimated planning cost, local government staff time and/or consultant time was multiplied by an appropriate compensation rate.
Regulatory Transaction Costs	The estimated expense to the regulated community associated with its new interactions with the implementing agency as a result of the proposed rule. There are five possible types of regulatory transaction costs (only the applicable ones were mentioned for each rule). Note that the staff time may apply to many different groups, including local government, industry, business, or consultant staff. The compensation rate used should be adjusted accordingly. ❑ Inspections ❑ Monitoring ❑ Periodic Reporting ❑ Permit Applications ❑ Permit Modification
Opportunity Costs	Opportunity costs associated with the proposed rule are costs to the regulated party due to one of the following effects of the proposed rule: ❑ Land opportunity costs ❑ Staff labor /time opportunity costs ❑ Redirecting of existing grant funding sources like ACSP
Other Costs	These are additional estimated costs that do not fall under the previous cost categories.

Implementing Agency Costs/Savings

The costs to DWQ in implementing the Falls Reservoir watershed NSW Rules represent opportunity costs for DENR to implement the rule component. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.

Description of the Implementing Agency	This part describes the branch, section, and unit of DENR that would be responsible for implementing the proposed rule. If this group is currently administering any similar programs, they would be described.
Regulatory Development Costs	This part describes the tasks and estimated opportunity costs for DENR to develop and propose this rule as well as make future modifications.
Monitoring and Recordkeeping Costs	This describes the tasks and estimated opportunity costs for DENR to ensure compliance with the proposed rule and to maintain the required records of compliance.
Permitting Costs	This part states the number and type of permits that would have to be processed each year by DENR staff and an estimate of potential opportunity costs to the agency.
Inspection and Enforcement Costs	This part describes the tasks and estimated opportunity costs for inspecting the regulated party and an inspection schedule if applicable.
Other Costs	If these are additional tasks and opportunity costs that do not fall under the previous categories, they can be covered in this section.

Chapter: 1 Benefits

The rulemaking process requires that agencies provide a description of the purpose and benefits of a proposed rule. The Division believes it is essential to recognize the benefits that regulations will provide. The characterization of water quality is very important to the overall reservoir system. Because the processes on the system are highly complex and intricate, many benefits are not readily quantifiable and many are 'non-market' in nature, making ascription of monetary values to them even more challenging. Some of these benefits are interlinked such as aquatic life and recreation or water storage and drinking water for example.

We focused on certain benefits because of their key importance. It is important to recognize that there is a large range of benefits provided by the reservoir and associated improved water quality. To provide the context we developed the following benefits types to provide a picture of the range of benefits (Table 1.1). The benefits listed in the table is not meant to be exhaustive but illustrates that there are many benefits some of which we have not been able to assign monetary values to. The estimated values provided are taken from reports discussed in the individual benefit sections below.

The benefit estimates in the first column are benefits that would accrue from successful implementation of the strategy and associated water quality improvement. The benefit estimate in the second column represent the estimated high and low range value of Falls Lake as a water supply. The high end estimated benefit is based on calculations provided by the City of Raleigh Public Utilities Department based on their assessment of available alternative sources of drinking water including Kerr Lake, PCS Phosphate dewater, and the Atlantic Ocean. Kerr Lake has was determined to represent the most likely estimated value of Falls Lake for this analysis based on its available volume for water supply. The high end replacement cost estimates for this scenario are provided in detail in Table 1.2. The low-end estimated benefit of the lake is based on cost information from the Lake Gaston Water Supply project in Virginia Beach, VA. The replacement cost estimates for this scenario are provided in detail in Table 1.3. A discussion of these benefits is provided the section below.

Table 1.1. Benefit Values of Falls Lake Watershed[1]

Benefit Types	***Estimated Strategy Benefit Value***	***Estimated Value of Falls Lake Water Supply[2]***
Avoided Drinking Water Treatment Costs	$43 million - $266 million	*
Reduced Drinking Water Treatment Costs	$600k - $800k[4]	*
Value of Falls Lake	*	$420 million - $1.1 billion[3]
Recreational Benefits	$179 million - $336 million	*
Local Economy and Property Values	*	*
Upstream Reservoir Improvements	*	*
Watershed Stream Improvements	*	*
Aquatic Life Benefits	*	*
Ecological/Food Chain Communities	*	*
Neuse Estuary Improvement	*	*

* While these benefits will occur we are unable to quantify them.
[1] Benefits were generated using various inflation & discount rates and are not directly comparable
[2] Estimated value of Falls Lake as a water supply is not additive with the strategy benefits
[3] Estimated Value of Falls Lake is in 2010 dollars – Not adjusted for Inflation / Discounted
[4] Annual Benefit – Not adjusted for Inflation / Discounted

The rules require all major sources of nutrients to implement a staged adaptive approach to reduce their loading to Falls Lake by 40% and 77% for nitrogen and phosphorus respectively. Because of the large nutrient reduction requirements, DWQ developed the staged implementation approach. This will require initial reductions in a first stage (Stage I) of the strategy followed by more substantial reductions in the second stage of implementation (Stage II). The staged implementation approach results in a lag between the reductions in nutrient loading and actual improvements to water quality. Because of this, many of the benefits described may not be fully realized for many years to come.

Algal productivity is often correlated to levels of nitrogen and phosphorus. Most species of algae are not harmful however, a harmful algal bloom (HAB) can occur when certain types of microscopic algae grow quickly in water, forming visible patches that may harm the health of the environment, plants, or animals. HABs can deplete the oxygen and block the sunlight that other organisms need to live, and some HAB-causing algae release toxins that are dangerous to animals and humans. Cyanobacteria, also known as blue-green algae, can produce toxins that may taint drinking water and recreational water. Humans who drink or swim in water that contains high concentrations of cyanobacteria or cyanobacterial toxins may experience gastroenteritis, skin irritation, allergic responses, or liver damage (CDC 2010). Molecular surveys of cyanobacterial communities were conducted at two sites (Sandling Beach and Beaver Dam) in Falls Lake in 2005. Water samples for analysis were collected biweekly from mid-summer to early fall. While no microcystin-producing HABs were detected, the structure of the cyanobacterial community suggests that Falls Lake has the potential for such blooms if environmental conditions change to favor these organisms (Yannarell 2005). Further reductions in nutrients may help to avoid any outbreaks of HABs. An aquatic life benefit for reducing the nutrient loading is the shift in algal communities away from the generally less desirable food base of blue-green algae and back toward a more balanced and robust composition of species that provides a more desirable food base for the entire aquatic community up through the fish and including wildlife that feed on fish and other higher aquatic organisms.

A survey conducted in the Catawba River basin, concluded that North Carolina and South Carolina residents' mean willingness to pay was $139 per year ($135 mean for North Carolinians was) for improved water quality (Kramer 2002). In addition, area residents indicated that protecting the health of the Catawba River basin is important. This importance placed a considerable monetary value on the protection of water quality in the basin over time. The monetary value, which is equivalent to an annual economic benefit provided by this resource was estimated at a value of over $75 million for taxpayers in the river basin. It can be assumed that residents in the Neuse River basin would also value better water quality and provide a similar willingness to pay for the Neuse River basin. This assumption relies on the similarities in population between the Catawba River and Neuse River basins. Based on 2000 census data the total population in the Catawba River basin is 1,279,569. In the Neuse River basin the total population data is 1,320,790 (Pate 2009). If residents in the Neuse River basin are willing to spend $139 for improved water quality that would equate to approximately $183,589,810 generated.

Drinking Water Quality Benefits

Assuming these reductions are met, the improvements in raw water quality can help lower drinking water treatment costs. In addition, reduced aesthetic concerns with treated drinking water such as taste and odor complaints should be lessened. It is anticipated that a lesser frequency of local government staff time responding to residents' complaints should be observed (NCDWQ 2007).

High levels of turbidity can mean increased costs to treat drinking water at municipal facilities. Turbidity, a measure of suspended sediments in water, serves as a common water quality metric. A research paper by Duke University, Valuing Drinking Water Provision as an Ecosystem Service in the Neuse River Basin (Elsin 2009) estimated avoided water treatment costs of between $2.6 and $16.6 million over a 30 year period (in net present value terms, using 4% discount rate) for 30 percentage reductions in raw water turbidity. Thus one estimable

value of sediment-reducing land management practices in upstream areas consists of these averted costs of water treatment.

To satisfy the goals of nutrient reduction, installation of best management practices (BMP) are required. These BMPs also provide co-benefit reductions in turbidity. Although we cannot estimate how much the BMPs will reduce turbidity, the agriculture, buffer and various stormwater rules will each have significantly varying beneficial effects on turbidity. In addition, individual compliance choices within in each rule will influence the extent of that reduction. The BMPs required for nutrient reduction have associated total suspended solids (TSS) reduction requirements of generally 85 percent and where multiple BMPs are required they each achieve 85 percent. The relationship between TSS and turbidity is not a linear relationship in addition each rule will have varying influences on flow which is another factor bearing relationship to TSS and turbidity. In sum these interactions will benefit water quality in Falls Reservoir however estimating the associated benefit costs cannot be estimated.

The City of Raleigh commented that high levels of nutrient pollutants also make water treatment much more costly. Of special concern is the content of Total Organic Carbon (TOC) in the lake (City of Raleigh 2009). TOC is produced by living organisms and is accumulated in Falls Lake from stormwater run off and promoted through the growth of algae or bacteria that thrive on nutrients from the run off. TOC components combine with chlorine, which is used to treat water, to create carcinogenic compounds. This process is called Disinfection By-Product formation. While the E.M. Johnson (EMJ) Water Treatment Plant is currently very successful in cleansing Falls Lake water of TOC problems through vigilant use of existing treatment processes and aggressive flushing of the City's potable water distribution system, Raleigh's Public Utilities staff warn that increased TOC at the plant will require the implementation of more sophisticated and much more expensive treatment methods. These new, advanced treatment processes use Activated Carbon or Magnetic Ion Exchange resin and could increase operational costs by 20 to 25% annually. This upgrade to a more elaborate treatment method also would require capital construction projects that have a projected price tag of $120 million tag. The total capital and O&M costs of the different treatment upgrade options that would be needed should Falls lake water quality continue to deteriorate are estimated to range $43 to $266 million when adjusted for inflation by 3% annually over 30 years and discounted at %5 to provide net present value in 2010 dollars (City of Raleigh 2009).

The City of Raleigh may have to commit resources for these improvements to their water treatment plant based on their current projections of raw water quality improvements. If water quality continues to decline, then the Safe Drinking Water Act will require the treatment process upgrades. However, if the rate of progress in reducing TOC is noticeable and occurs prior to committing funds to these treatment process improvements, then these would-be expenditures are then "avoided costs".

Using the underlying assumption that water quality will improve as a result of the Falls Lake Rules, the City of Raleigh Public Utilities department was able to estimate annual average costs savings at EMJ related to reductions in current treatment costs. This benefit estimate assumes the greatest impact to the total annual O&M cost would be the reduced use, and therefore the reduced cost, of chemical treatment. In the plants adopted budget for 2010, $6.1 million is attributed to chemical costs out of an $18.4 million dollar budget. Assuming that TOC is directly proportional to the amount of chemical used in the treatment process, the estimated annual savings from reduced chemical needs was calculated to be approximately $800,000 per year. However, not all chemicals in the treatment process are equally impacted by TOC concentrations so it was assumed only 75% of the total chemical costs savings would be directly related to better source water quality resulting in an estimated annual savings of $600,000 in reduced treatment costs. This estimated annual benefit in cost savings is presented in Table 1.1. It has not been compounded and adjusted for inflation.

This estimated reduction in treatment costs was calculated by bracketing water quality data into time periods exhibiting the best and worst water quality, based on current available data. The time period of 2001 to 2005 proved to have the best water quality, on average over the period of record at 5.92 ppm TOC. The time period 2006 to 2009 had the worst water quality at 6.7 ppm TOC. The city has estimated an increase in water demand of demand of 2.14% per year for the next 30 years. The cost of chemical treatment would be expected to increase

proportionally due to the increase in water treated to meet demand. (City of Raleigh Public Utilities Department, personal communication May 13, 2010).
While not additive to the costs avoided through water quality improvement, there is also value in having Falls Lake as a water supply. A high and low end value estimated value were calculated based on what the range of estimated costs would be to use a suitable replacement to Falls Lake as a water supply. The City of Raleigh Public Utilities Department conducted an assessment of available alternative sources of drinking water including Kerr Lake, PCS Phosphate dewater, and the Atlantic Ocean. Kerr Lake was determined to represent the most likely estimated value of Falls Lake for this analysis based on its available volume for water supply. The high end replacement cost estimates for this scenario are provided in detail in Table 1.2. The low-end estimated benefit of the lake is based on cost information from the Lake Gaston Water Supply project in Virginia Beach, VA. An overview of how the replacement cost estimates for this scenario were calculated is provided in Table 1.3.

The assessment of suitable replacements was based on the fact that Falls Lake's average daily yield of 69 MGD is an average day metric. For the City to be able to meet maximum day needs, they need to assume a peaking factor of 1.5, which is consistent with previous water supply and treatment planning for Raleigh. Therefore, the assessment of suitable replacement water supplies involved a review of the cost of facilities required to transfer a little over 100 MGD of water to the EMJ plant. Based on a comparison of volume, runoff area, the City assumed inflow distribution for Falls Lake is similar to Kerr Lake and concluded it is realistic to think the entire yield may be available from Kerr Lake. Another important assumption made is that water would most likely need to be returned to Kerr Lake. The cost estimates in table 1.2 therefore include major transmission facilities to and from Kerr Lake. These rough cost estimates suggest a project cost of approximately $1.1 billion. About 60% of those estimated costs are for the raw water supply to Raleigh, and the remaining 40% addresses the effluent return assumption. These costs are based on high-level estimates and include construction, 25% for implementation costs, and another 25% for contingencies. A breakout of the cost estimate for 69 MGD of Yield From Kerr Lake Delivered to the City of Raleigh's E.M. Johnson WTP is provided in Table 1.2 below.

Table 1.2 Benefit of Falls Lake - Capital Cost Component

Construction Costs	**Cost**
Kerr Lake Intake	$39,000,000
Kerr Lake Raw Water Pump Station	$69,500,000
Raw Water Transmission to E.M. Johnson WTP*	$267,000,000
Raw Water Booster Pump Station	$32,800,000
Neuse River WWTP Effluent Return Pump Station***	$28,800,000
Neuse River Effluent Return Transmission**	$222,700,000
Effluent Booster Pump Stations	$40,700,000
Subtotal (1)	$700,400,000
Capital Cost Allowance	
Engineering Studies, Design, and Construction Services (15% Subtotal 1)	$105,100,000
Subtotal (2)	$805,500,000
Legal Fees, Permits, and Approvals (5% Subtotal 1)	$35,000,000
Subtotal (3)	$840,500,000
Contingency (25% of Subtotal 3)	$210,100,000
Total Estimated Project Capital Costs	**$1,050,600,000**

Notes:
*Includes Easement Acquisition Assumptions
**Includes Easement Acquisition Assumption and Discharge Structure
*** Assumes water returned to Kerr Lake
In order to provide a range of estimates for valuing Falls Lake as a water supply, cost information from Lake Gaston Project in Virginia Beach was used. The Lake Gaston Project is involves a facility, intake and pump

station on the Pea Hill Creek tributary, that can transfer water from the Lake to southeastern Virginia at a maximum capacity of 60 mdg of water. 76 miles of 60-inch diameter pipes were buried to connect the station to the discharge site. Based on costs from the Gaston project and assuming that the effluent return transmission would double essentially double the direct costs of the Gaston project, the total cost estimate for Raleigh as of 2020 would be $420 million.

Table 1.3 Benefit of Falls Lake - Capital Cost Component based on Lake Gaston Project

Indirect Project Costs		**Costs ($ million, in 2010)**
Preliminary Surveys		$2.09
Financial Planning		$0.64
Engineering & Design		$12.55
Site Acquisition		$6.27
Storage in Kerr Reservoir		$3.86
Legal / Regulatory		$19.14
Local Consent Payments		$14.48
Other Expenses		$3.06
Total Indirect Costs:		**$62.09**
Direct Project Costs		
Transmission & Distribution Mains	*Feet*	
Six River Crossings	2,210	$15.12
Pipeline Contract C-1	86,400	$52.44
Pipeline Contract C-2	87,010	$58.88
Pipeline Contract C-3	88,160	$54.37
Pipeline Contract C-4	79,750	$50.19
Pipeline Contract C-5	47,650	$30.89
PS Contract D-1	9,000	$8.37
Construction Administration/Inspection		$28.63
Subtotal		$298.89
Structures and Improvements:		
Pump Station		$29.92
Flow Control Structures		$10.94
Construction Administration/Inspection		$4.18
Sub-total:		$45.04
Electric Pumping Equipment		
Electric Pumping Equipment		$12.87
Construction Administration/Inspection		$1.29
Subtotal		$14.16
Total Direct Costs		**$358.09**
Total Project Costs		**$420.19**

Recreational Benefits

Assuming the reductions are met, improved conditions for primary contact recreation which include swimming, fishing, boating, and skiing are expected. An overall increase in lake user-days was correlated with improved water quality (Egan 2004). Additional benefits include a correlated increase in related recreation such as camping, hiking, and wildlife viewing.

A recreation demand model was recently developed by Dr. Roger H. von Haefen with the Department of Agricultural and Resource Economics at North Carolina State University. The model generates benefit estimates and assumes that for every year between 2011 and 2040, every adult resident of North Carolina and Virginia would decide whether and how often to engage in water-based outdoor recreation (e.g., boating, fishing, swimming, picnicking, nature watching and hiking) at 14 North Carolina state parks. The model predicted for Falls Lake and Eno River State Parks to experience significant water quality improvements with the proposed nutrient reduction rules. The recreation demand model assumes that individuals tradeoff travel costs (both money and time) and water quality when deciding whether and how often to recreate. A cleaned-up water body will be more attractive to recreators and therefore generate more intensive use and benefits to society (von Haefen 2010). The results from the sensitivity analysis suggest that undiscounted benefits for North Carolina residents from the watershed-wide Falls Lake nutrient management strategy will be between $636 million and $1.326 billion over 30 years. Assuming a seven percent discount rate, the present value of these benefits ranges from $179 million to $336 million. The relatively large divergence between undiscounted and discounted benefit estimates is a reflection of the relatively high discount rate and the fact that most benefits arise in the distant future. These benefit estimates pertain only to recreation inside Falls Lake and Eno River State Parks, although the proposed nutrient reduction rules will improve water quality throughout the Falls Lake watershed. To the degree that water-based outdoor recreation opportunities improve outside these state parks but within the watershed, aggregate recreational benefits will be larger (von Haefen 2010).

Table 1.4 Recreational Benefits of Falls Lake Nutrient Management Strategy

Recreational Benefit Estimates, 2011-2040 (in millions of 2010 $s)		
	Undiscounted	**7% Discount Rate**
Benefits accruing to NC residents (baseline)	$853	$235
Benefits accruing to VA residents (baseline)	$19	$6
Sensitivity analysis with respect to economic assumptions (benefit estimates for NC residents only)		
1) Assume no increase in trips with policy intervention at Falls Lake and Eno River State Parks	$657	$189
2) Assume opportunity cost of time is one-half the wage rate (baseline assumption is one-third)	$1,076	$297
3) Assume opportunity cost of time is one-quarter the wage rate (baseline assumption is one-third)	$745	$205
4) Assume marginal willingness to pay for improvements in water quality rises at the rate of 1.5 percent per year (baseline assumption is no growth)	$1,326	$336
Sensitivity analysis with respect to water quality assumptions (benefit estimates for NC residents only)		
5) Slower degradation in mean Chl-A readings in the absence of policy intervention (1% versus 1.5% annual degradation)	$636	$179
6) Faster degradation in mean Chl-A readings in the absence of policy intervention (2% versus 1.5% annual degradation)	$1,097	$298
7) Smaller improvement in mean Chl-A readings with policy intervention (15% and 30% versus 25% and 40% below 2006 levels at Falls Lake and Eno River State Parks, respectively)	$704	$193
8) Larger improvement in mean Chl-A readings with policy intervention (35% and 50% versus 25% and 40% below 2006 levels at Falls Lake and Eno River State Parks, respectively)	$1,013	$280
Overall range	$636-$1326	$179-$336

The benefit estimates reported in Table 1.4 were generated with a recreation demand model developed by Dr. Roger H. von Haefen.[1] The model assumes that for every year between 2011 and 2040, every adult resident of North Carolina and Virginia decides whether and how often to engage in water-based outdoor recreation (e.g., boating, fishing, swimming, picnicking, nature watching and hiking) at 14 North Carolina state parks. Two of the 14 state parks – Falls Lake and Eno River – are located in the Falls Lake watershed and predicted to experience significant water quality improvements with the policy intervention. The recreation demand model assumes that individuals tradeoff travel costs (both money and time) and water quality when deciding whether and how often to recreate. A cleaned-up water body will be more attractive to recreators and therefore generate more intensive use and benefits to society.

Calibration of the recreation demand model relied on several data sources. 2000 Census data for all zip codes in North Carolina and Virginia were used to spatially identify the origin of all potential recreators at Falls Lake and Eno River as well as populations, incomes, and wages. The distance and travel time from each origin zip code to each of the 14 state parks were calculated with the software package *PC Miler*. Time costs (valued at one-third the wage rate as is typical in recreation demand analysis) were added to money costs (gasoline plus maintenance and repair) to arrive at a round-trip travel cost for each origin zip code-site combination. 2006 water quality data for Chlorophyll-A and five other chemistry variables were obtained for Falls Lake and Eno River from DWQ. These water quality chemistries were transformed into summary measures of water quality using a water quality model based on expert-elicitation data. Aggregate visitation data from NC's Department of Parks and Recreation for each site from 2006-2009 were used to calibrate the model's trip predictions at all 14 sites. Falls Lake staff also provided estimates of the number of multi-day trips to the park as well as the number of trips that were not water-based (e.g., mountain biking trips). Finally, information on individual's willingness to tradeoff travel costs and water quality were obtained from statistical analysis of choice experiment data collected through a EPA and WRRI-funded Knowledge Networks on-line survey.

Predictions for how water quality will likely change with and without the policy intervention over a 30-year time horizon were generated with the assistance of DWQ staff. The dynamics of other key variables – preference parameters, park visitation rates, population (especially Wake and Durham counties), incomes, wages, gas prices, automotive fuel efficiency, and maintenance and repair costs – were specified based on historical trends and expert judgment. Where possible, sensitivity analysis was conducted to gauge how aggregate benefit calculations change with alternative plausible specifications for the evolution of these variables.

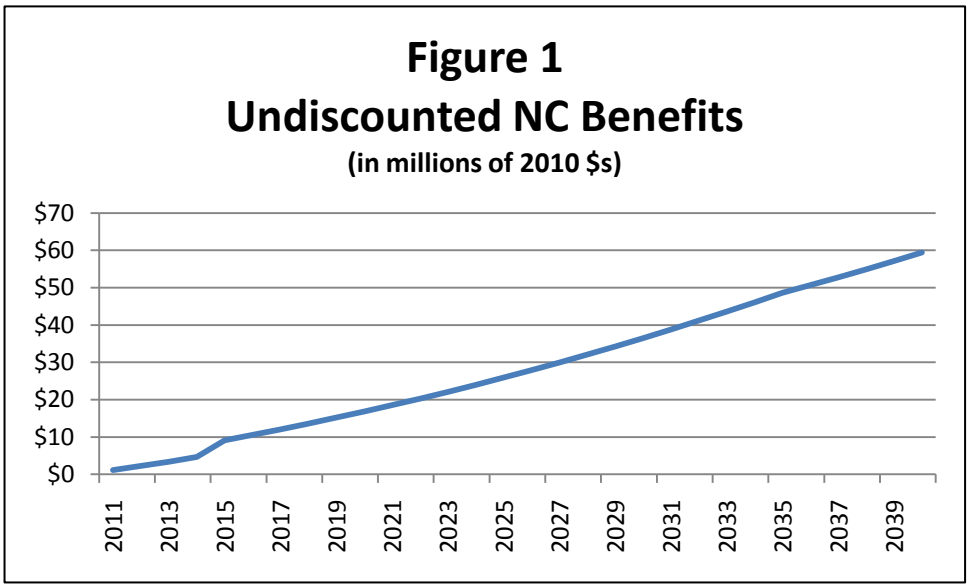


Figure 1 reports the stream of undiscounted recreational benefits of the policy in the baseline model for North Carolina residents. The figure suggests the benefits are small initially when the policy intervention has minimal effects on ambient water quality in Falls Lake and Eno River. Over time, the intervention generates larger benefits as the cumulative improvements in water quality rise. As reported in Table 1, most of these benefits are realized by North Carolina residents.

Sensitivity analysis reveals several of the important assumptions that drive the aggregate benefit estimates. A prediction of the baseline model is that in year 2040, the policy intervention will generate a ninety percent increase in recreation trips at Falls Lake and Eno River. This finding is driven by the dramatic improvement in water quality the policy intervention is expected to generate, but such a large increase in visitation may result in increased congestion that would partially offset the attractiveness of water-based recreation in the parks. To evaluate this possibility, we consider the case where the improvement in water quality would not generate any increase in the number of visitors in the parks due to congestion effects. Alternative specification #1 suggests that in this extreme case the undiscounted benefits of the policy would be roughly 23 percent lower.
Alternative specifications #2 and #3 employ different assumptions about the opportunity cost of time, a factor that previous recreation demand studies have identified as important for benefit estimation. Relative to the baseline assumption of one-third the wage rate, a higher opportunity cost of time of one-half the wage rate generates undiscounted benefit estimates that are 26 percent higher than baseline. Conversely, a lower opportunity cost of time of one-quarter the wage rate generates undiscounted benefits 13 percent below baseline.
Alternative specification #4 allows for the possibility that individual's willingness to pay may rise with income over time. Environmental economists have accumulated considerable evidence that society is willing to pay more for environmental improvements as it becomes wealthier. To reflect this possibility, we assume willingness to pay rises at the same rate as income, 1.5 percent per year. Results from this specification imply a much larger (55 percent) aggregate undiscounted benefits.

Alternative specifications #5-8 assess how sensitive benefit estimates are to alternative treatments of water quality with and without the policy. Recall the policy's goal is defined in terms of reducing Chlorophyll-A water chemistry levels. In the baseline model, mean Chlorophyll-A readings are assumed to increase at a rate of 1.5 percent per year at Falls Lake and Eno River without the policy intervention. With the policy intervention, mean readings are predicted to fall to 25 percent below 2006 levels at Falls Lake by 2040, and 40 percent below 2006 levels at Eno River by 2040. Considerable uncertainty should be attached to these estimates, and thus we consider alternative assumptions. For alternative specification #5, we assume a slower Chlorophyll-A degradation rate of one percent in the absence of policy. This assumption implies a smaller improvement in water

quality with the policy and thus a 25 percent reduction in undiscounted benefits. Conversely, alternative specification #6 assumes a faster degradation rate of two percent in the absence of policy and thus a larger water quality improvement with the policy. Results suggest a 29 percent increase in undiscounted benefits in this case. For alternative specification #7, we assume the improvement in water quality at Falls Lake and Eno River is less than anticipated. For this scenario we find benefit estimates fall by 17 percent assuming mean Chlorophyll-A readings fall by 15 percent and 30 percent relative to 2006 levels at Falls Lake and Eno River. Finally, for alternative specification #8, we assume Chlorophyll-A levels fall by more than anticipated with the policy. Assuming a 35 and 50 percent reduction in mean levels relative to 2006 conditions, the recreation demand model predicts net benefits will be 19 percent higher than the baseline.

In sum, results from the sensitivity analysis suggest that undiscounted benefits from the watershed-wide Falls Lake nutrient management strategy will be between $636 million and $1.326 billion. Assuming a seven percent discount rate, the present value of these benefits ranges from $179 million to $336 million. The relatively large divergence between undiscounted and discounted benefit estimates is a reflection of the relatively high discount rate and the fact that most benefits arise in the distant future.

When interpreting these estimates, a number of considerations should be kept in mind. First, these benefit estimates pertain only to recreation inside Falls Lake and Eno River State Parks, although the policy intervention will improve water quality throughout the Falls Lake watershed. To the degree that water-based outdoor recreation opportunities improve outside these state parks but within the watershed, aggregate recreational benefits will be larger. In addition, these benefit estimates do not account for aesthetic and property value benefits, avoided water treatment costs, and other ecosystem services that are difficult to monetize.

Additional details for how these benefit estimates were constructed can be found in a forthcoming WRRI report authored by Dr. von Haefen.

Local Property Value Benefits

Land prices are usually higher for land parcels close to lakes because of the views and boating or fishing opportunities (Kramer 2005). The greater desire to locate housing and businesses near the lake, benefit a productive economy (NCDWQ 2007).

Local Economy Benefits

Similar to the benefits to local property values, improved water quality resulting in an increased desire to live in proximity to a healthy natural resource would be expected to have a positive impact on the local economy within the watershed.

Water Storage Benefits

Assuming the reductions are met, there are several benefits to consider regarding upstream public water supply reservoirs located in the Falls Lake watershed. Since the proposed nutrient management strategy targets nonpoint sources of pollution or stormwater runoff, sedimentation (or the “filling in” of sediment) to the smaller upstream water supply reservoirs would occur more slowly. This could reduce the need for potential future dredge projects to restore volume capacity. Costs associated with developing a future water supply reservoir could be avoided by utilizing these existing reservoirs. In addition, future nutrient reduction costs may be prevented for these existing reservoirs (upstream of Falls Lake).

Aquatic Life Benefits

Reduced occurrences of algal blooms and sediment contributions due to lower nutrient loading in the watershed would assist in meeting the water quality standard for turbidity and chlorophyll-*a*. In addition, the reduction in nutrient inputs will improve the aquatic environment with healthier dissolved oxygen and pH levels.

Neuse Estuary Improvement Benefits

Assuming these reductions are met, less nutrient loading is expected to leave Falls Lake at the Dam. Less loading coming from Falls Lake will help downstream affected parties who are mandated to reduce nutrient loading in the Neuse River Basin under the Nutrient Sensitive Waters (NSW) Management Strategy. The Neuse NSW rule establishes the goal of reducing the average annual load of nitrogen delivered to the Neuse River Estuary from point and nonpoint sources by a minimum of 30% of the average annual load. Since full implementation of the nutrient reduction strategy in 2003, nitrogen loads from point sources have been reduced by 65% and agriculture has reduced their estimated nitrogen loss from cropland and pastureland by approximately 45%. Despite this successful implementation, the goal of an overall 30 percent reduction in nitrogen loading does not appear to have been met, and the Neuse River Estuary impairment has increased in acreage (NCDWQ 2009). In light of the fact that trend evaluations suggest that the 30% reduction has not been met, and recognizing that certain sources are not addressed or not fully addressed under the current strategy, staff have begun an evaluation of the limitations of the current strategy and identified opportunities for developing a better understanding of the nutrient dynamics of this complex system. One recommendation was to lead in the development of the Falls of the Neuse Reservoir Nutrient Management Strategy (NCDWQ 2009).

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Chapter 2: Stormwater for New Development

Step 1: Basic Information

1.1 Rule Reference No.	.0277
1.2 Analyst	Rich Gannon, Environmental Supervisor John Huisman, Environmental Senior Specialist Heather Jennings, Environmental Specialist
1.3 Office	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Phone	(919) 807-6300
1.5 Comments on Agency Contact	Phase II Stormwater Information - Bill Diuguid, Division of Water Quality Stormwater Unit (919) 807-6369
1.6 Title of the Proposed Rule	Falls Lake Water Supply Nutrient Strategy: Stormwater Management for New Development
1.7 Citation	15A NCAC 2B .0277
1.8 Brief Description of the Proposed Rule	This rule requires all local governments in the Falls Lake Watershed to develop and implement permitting programs to require stormwater controls that meet subwatershed nutrient loading rate targets on new development activities. Developers would be required to control nutrient export to certain levels onsite, and may meet remaining reduction needs through offsite measures, including in-lieu fee payment to the North Carolina Environmental Enhancement Program (NC EEP), to private banks, or to local governments with a Division-approved offset program. Control of flows for stream protection is also required. Development in existing water supply watersheds would continue to meet those density-related treatment requirements and density caps where they are more stringent than this rule. Within two months after effective date, the Division would submit a model local program, including a model ordinance, to the Commission for approval. Within another five months, local governments would submit stormwater programs for Division review and subsequent Commission approval. As early as 18 months after effective date, local governments would adopt and implement their local stormwater management programs. Upon implementation, local governments would be required to submit annual reports to the Division.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table x of the Summary.

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint. Developed land uses currently comprise at least one-third of nonpoint inputs to the lake. While nutrient export rates from developed lands vary, they have the potential to export at rates exceeding those of cropland. The watershed includes high-growth area largely associated with Durham. Watershed-wide average projected growth rate through 2036 is 1.7% per year. New development left unaddressed will add significant new nutrient loading to Falls Lake.

3.2 How does the Proposed Rule Change Behavior?

Local Governments: This rule would require all local governments in the Falls Lake Watershed to develop and implement programs, including ordinances that carry out permitting requirements for post-construction, engineered stormwater controls (BMPs) that will meet subwatershed nutrient loading rate targets and runoff flow limits on new development activities for the life of those developments. This would include ensuring continued BMP operation and maintenance over time and through ownership changes. Local governments would obtain Division approval for their programs and would report implementation progress to the Division annually. Thus, they would function as both regulated parties and implementing agencies under this rule.

Local Government Regulatory Baseline - Municipalities: As identified in Table 2.1 below and detailed in Table B.1 in Appendix B, municipalities currently implement a combination of three separate state stormwater mandates that together subject the entire watershed to at least one, and typically two or three, sets of control requirements. All municipalities (and counties) implement *Water Supply Watershed* programs in large portions of their areas within the Falls watershed, dictated by protection requirements for either Falls Reservoir or smaller water supply reservoirs that drain to Falls Reservoir. Four of eight municipalities - Durham, Hillsborough, Raleigh, and Wake Forest – currently implement both *NPDES Stormwater Phase II* programs throughout their jurisdictions and *Neuse nutrient strategy stormwater* requirements throughout the Falls portion of their jurisdictions. Three of the remaining four were designated in January 2010 by the Environmental Management Commission for implementation of Phase II requirements following submission and approval of permits. Thus, all municipalities are implementing new development permitting programs now and many will implement additional requirements by the time they would implement this rule. To implement this rule, additional responsibilities will involve reviewing additional application information and in some cases ensuring that additional practices are included to address nutrient targets and, in the few water supply-only jurisdictions where peak flow control is not required, ensuring that peak flow rates are met. Overall, we do not expect that Falls municipalities will incur significant additional administrative costs to implement this rule.

Local Government Baseline - Counties: Counties currently implement one or both of two state stormwater mandates that together subject the entirety of county area in the watershed to control requirements, as shown in Table 2.1 below and detailed in Table B.1 in Appendix B. Water supply watersheds encompass approximately 93% of the land area in the Falls watershed, and counties

administer WSW stormwater programs in those areas of their jurisdictions. In addition, the three largest and most populous counties in the watershed – Durham, Wake and Orange – implement stormwater requirements under the Neuse River Basin nutrient strategy. The weight of new development activity in unincorporated areas falls more heavily within municipalities' extraterritorial planning jurisdictions, where permitting would fall to municipalities. Considering these factors, overall we do not believe that counties would incur significant additional administrative costs to implement this rule.

Table 2.1. Existing Stormwater Regulations Affecting Development in the Falls Watershed

	WSW						WSW				
Municipality	II	III	IV	NPDES Ph II	Neuse NSW	County	II	III	IV	NPDES Ph II	Neuse NSW
Butner			✓	✓		Durham	✓	✓	✓	✓+	✓
Creedmoor			✓	✓		Franklin			✓	✓+	
Durham			✓	✓	✓	Granville	✓		✓		
Hillsborough				✓	✓*	Orange	✓		✓	✓+	✓
Raleigh			✓	✓	✓	Person			✓		
Roxboro		✓		✓		Wake			✓	✓+	✓
Stem	✓										
Wake Forest			✓	✓	✓						

* Voluntary implementation + DWQ implementation

Developers: Developers would estimate nutrient export and stormwater flow rate from proposed projects along with reductions in these parameters needed onsite and altogether to meet the requirements of this rule. They would design structural BMPs to meet onsite requirements and seek offsite reductions as needed and to the extent that they qualify for this option. They would ensure that they meet requirements of all stormwater regulations. They would be responsible for making arrangements for long-term operation and maintenance of constructed stormwater conveyance systems and BMPs.

Developers Baseline: In addition to the locally implemented stormwater requirements described above, as detailed in Table 2.1 above a majority of county land in the Falls watershed, embodying most of the developing county area is subject to NPDES Phase II stormwater permitting requirements implemented by the Division. The combination of WSW and Phase II requirements covering the entire watershed means that essentially all new development with greater than 24% impervious cover in the Falls watershed is or will be required to provide onsite stormwater treatment and peak flow attenuation. Treatment is required to achieve 85% TSS removal, which can be achieved with any one of the most commonly used practices – constructed wetland, wet detention, bioretention, sand filter, or an infiltration device – or with a combination of lesser practices. In addition, Neuse stormwater requirements involve a fixed 3.6 lb N/ac/yr loading rate target. Nitrogen loading rate increases as development intensity increases, necessitating additional controls beyond a single practice at higher intensities, or offsite measures, to meet the fixed rate target. However, the WSW rules also impose absolute density ceilings of 50% (WS-III) and 70% (WS-IV), limiting untreated loading rates to approximately 8.5 – 12.5 lb N/ac/yr and .95 – 1.2 lb P/ac/yr. Neuse requirements will apply to the great majority of new development.

This rule has the same basic design as the Neuse rule, with a more stringent nitrogen rate target of 2.2 lb N/ac/yr and a phosphorus target of .33 lb P/ac/yr. A majority of developers would incur additional costs under this rule. Additional treatment need would primarily affect the more intensive commercial, industrial and multi-family residential development.

Property Owners: In most cases, property owners would inherit long-term operation and maintenance responsibilities for stormwater BMPs from developers. To the extent that this rule results in additional

BMPs beyond those imposed by Phase II, WSW, and Neuse regulations as described above, property owners would inherit those additional maintenance costs.

Table 2.3. Implementation Timeline for New Development Stormwater Rule

Activity	**Assumed Date***	**Elapsed Time After Effective Date**
Effective Date	1/2011	0 month
DWQ seeks EMC approval of model local program	3/2011	2 months
LGs submit stormwater programs	8/2011	7 months
DWQ reviews and requests EMC approve of LG stormwater programs	1/2012	12 months
EMC Approval		
LG adopt and implement permitting programs	7/2012	18 months
LGs provide annual reports to DWQ documenting program's Progress		

Step 4: Identify Impacts

Table 2.4 below provides a summary of costs to all affected parties. The full, inflated costs for all ten years of Stage I are provided. In addition, we provide the total costs for Stage I, Stage II, and Stages I+II discounted to net present value. For most entries we provide a cost range representing low-end and high-end estimates.

Table 2.4: Summary of Costs to Affected Parties

Year	Private						Local Gov't	State Gov't (Oppor-tunity)	Total
	Developers				Prop Owners	Private Total			
	Capital	Planning	Reg Trans	Total	O&M				
2011	0	0	0	0	0	$0	$220k	$680 k	$900k
2012	$5.2 - 9.6 m	$1.2 - $2.1 m	$.97 - $2.8 m	$7.4 - $14.6 m	$90 - $110 k	$7.4 - $14.7 m	$110 - $271 k	$100k	$7.7 - $15.2 m
2013	$5.4 - 10.0 m	$1.2 - $2.2 m	$1.0 - $2.9 m	$7.6 - $15.1 m	$180 - 210 k	$7.8 - $15.3 m	$120 – $281 k	$110k	$8.0 - $15.9 m
2014	$5.6 - 10.4 m	$1.3 - $2.3 m	$1.04 - $3.0 m	$7.9 - $15.7 m	$270 - 330 k	$8.2 - $16.0 m	$120 – $291k	$110k	$8.4 - $16.6 m
2015	$5.8 - 10.7 m	$1.3 - $2.4 m	$1.08 - $3.2 m	$8.2 - $16.3 m	$370 - 450 k	$8.6 - $16.7 m	$130 – $302 k	$110k	$8.8 - $17.3 m
2016	$6.0 - $11.1 m	$1.4 – $2.5 m	$1.12 - $3.3 m	$8.5 - $16.9 m	$470 - 570 k	$9.0 - $17.4 m	$130 – $320 k	$110k	$9.2 - $18.0 m
2017	$6.2 - $11.5 m	$1.4 - $2.6 m	$1.16 - $3.4 m	$8.8 - $17.5 m	$580 - $690 k	$9.4 - $18.2 m	$130 - $330 k	$80k	$9.6 - $18.8 m
2018	$6.5 - $12.0 m	$1.5 - $2.7 m	$1.20 - $3.5 m	$9.2 - $18.1 m	$690 - $820 k	$9.8 - $18.9 m	$140 - $340 k	$80k	$10.1 - $19.6 m
2019	$6.7 - $12.4 m	$1.5 - $2.7 m	$1.24 - $3.6 m	$9.5 - $18.8 m	$800 - $960 k	$10.3 - $19.7 m	$140 - $350 k	$80k	$10.5 - $20.4 m
2020	$6.9 - $12.8 m	$1.6 - $2.8 m	$1.29 - $3.8 m	$9.8 - $19.4 m	$920 k - $1.1 m	$10.7 - $20.5 m	$150 - $370 k	$80k	$10.9 - $21.2 m

Projection of costs for points 10 years and further into the future involves a great deal of uncertainty. There is reason to believe that costs may ultimately be less than the values projected below.

NPV Stage I	**$36.2 - $66.9 m**	**$8.3 - $14.9 m**	**$6.7 - $19.6 m**	**$51.2 – $101 m**	**$2.7 - $3.2 m**	**$54.0 - $104 m**	**$990k - $2.1 m**	**$1.2 m**	**$56.1 - $109 m**
NPV Stage II	**$40.8 - $75.5 m**	**$9.4 - $16.8 m**	**$7.6 - $22.1 m**	**$57.8 - $114 m**	**$8.7 - $10.4 m**	**$66.5 - $125 m**	**$850k - $2.2 m**	**$400k**	**$67.7 - $129 m**
NPV Stage I+II	**$77.0 - $142 m**	**$17.7 - $31.6 m**	**$14.3 - $41.7 m**	**$109 - $216 m**	**$11.4 - $13.6 m**	**$120 - $229 m**	**$1.80 - $4.3 m**	**$1.60 m**	**$124 - $238 m**

Identify Impacts	This rule is likely to have a substantial impact on ***small businesses***. The great majority of costs estimated here would likely be experienced by businesses that could be classified as small businesses. The definition for small business provided by the Office of State Budget and Management is: *"a business entity, including its affiliates, that (i) is independently owned and operated and (ii) employs fewer than 500 full-time employees or has gross annual sales of less than $6 million".* According to staff with the Durham/Orange County Homebuilders' Association, the vast majority of developers in North Carolina are independently owned businesses and employ far fewer than 500 people. Most follow a model of a staff numbering a handful of people at the most that subcontracts the different components of construction to other small business subcontractors that cumulatively still fall far below a threshold of 500 people. Durham/Orange HBA staff notes that less than half but a significant percentage of development businesses would exceed the $6 million gross sales threshold simply given the high price of some housing. Nevertheless, the vast majority of developers in the watershed would likely be considered as fitting the character of small business (Durham/Orange HBA, 2010). As additional information, the National Association of Homebuilders Members' Census for 2009 showed that 58% of member builders had companies of fewer than 5 employees, and 81% had fewer than 10 employees. Also, 87% of members estimated their company's business to be less than $5 million dollars per year (NAHB, 2009). Information from the Durham/Orange Homebuilders' staff is that the business profile for the construction industry is largely consistent nationwide, with North Carolina fitting the general profile very closely. While the Association is a subset of all builders in the country, this information agrees with the broader characterization given above. Finally, a factsheet from the US Small Business Administration Office of Advocacy estimated that for North Carolina, construction businesses with fewer than 20 employees represented 98.1% of all construction businesses in 2006-2007 (SBA, 2009). All indicators are that essentially all developers in the watershed are likely to be small businesses using the "number of employees" threshold, while a large fraction, perhaps 75 – 90%, would be small businesses by the "gross sales" threshold. While the great majority of this rule's costs may fall on small business, this business sector has the ability to pass costs through to its customers. It seems reasonable to assume that a significant portion of new costs will be shifted to consumers and businesses purchasing or renting real estate. This is supported by frequent assertions to this effect by the Homebuilders' Association when discussing impacts from rules of this nature.

General Assumptions	The following are broad assumptions made in developing the costs in this chapter: 1. Instead of separate calculations for each local government, we carry out all calculations for the entire watershed, divided into 3 development types – county residential, municipal residential, and commercial/industrial/multi-family residential. We assume that the characterization we developed for each type provides a reasonable central tendency for the variations that will occur across projects, jurisdictions and time. 2. We project annual acres of new development using a several-step process that begins with population data from the 2000 Decennial US Census (Census) and that uses county population growth projections from the NC Office of State Budget and Management (OSBM). This data is drawn from Pate, 2009. We assume several things through these steps, including the following: o That population growth is uniform across Census blocks within a county, allowing us to infer growth in Falls watershed's portions. o That growth projections made through 2020 will continue through 2036, the end of the analysis period. We estimate average annual growth rate for the watershed as 1.7 % per year. o That developed lands will grow at the same rate as population. 3. Types of new development will occur in the same proportions as those types existed in 2000 as interpreted through Multi-Resolution Land Cover data available from the National Land Cover Database. To estimate loading rates from the 3 developed land uses, we rely on literature values for the Albemarle-Pamlico region and an export method developed by NCSU for Tar-Pamlico stormwater rule implementation that is applicable to this area, the Tar-Pamlico export method, Piedmont Version. We assume that values produced by this runoff loading method may be compared to literature loading values, and that the method provides a reasonable approximation of loading changes to surface waters in the watershed and to Falls Reservoir. 4. We calculate low-end cost values assuming full allowable use of offsite reduction options, and high-end values assuming use of onsite BMPs exclusively combined with conservative unit cost information. Conservative estimates are based on costs provided by the Raleigh/Wake County and Durham/Orange County chapters of the NC Homebuilders' Association (HBA, 2010). 5. All future-year values in Table 2.4 and throughout this chapter have been inflated from 2010 using the NC Consumer Price Index. Individual year NC CPI factors used are included in calculation tables provided in Appendix B. All net present value calculations are based on these inflated values and assume a 7% discount rate based on guidance from the Office of State Budget and Management. 6. Loading rate and BMP cost-effectiveness calculations indicate that collectively, nitrogen will require greater levels of control at higher cost than phosphorus, with phosphorus requirements being met through co-control at no added cost. Therefore our calculations assume that nitrogen costs are full costs. Because the treatment requirements of the two nutrients are comparatively close, given the uncertainties associated with our estimates and the expected variation in comparative requirements from site to site we assume no monetary trading benefit from the excess phosphorus control that we estimate would occur.

	7. To avoid undue calculation complexity we assumed uniform applicability of WSW, Phase II and Neuse stormwater requirements in estimating baseline loading rates. In fact none of these regulations have uniform geographic coverage. From this perspective we have likely underestimated costs. However, the vast majority of new development is subject to WSW and NPDES Phase II regulation, and the great majority is likely subject to Neuse stormwater requirements. Section 3.2 above provides a detailed discussion of baseline regulatory coverage.

Data Sources	In this chapter, we make reference to the following sources: ○ Durham/Orange HBA, 2010. Personal communication with Frank Thomas, Director of Government Relations, Durham/Orange County chapter of the NC Home Builders Association. ○ Falls Lake Watershed Model, June 2009, developed by NC Division of Environment and Natural Resources, Division of Water Quality, Modeling/TMDL Unit. ○ HBA, 2010. Information provided by the Raleigh/Wake County and Durham/Orange County chapters of the NC Homebuilders' Association. ○ Hunt, WF and A. Wossink, 2003. An Evaluation of Cost and Benefits of Structural Best Management Practices in North Carolina. ○ Hunt, W.F, 2006. BMP Costs and Removal Amounts. Attachment 10 in Report of Proceedings on the Proposed Changes to 15A NCAC 02B .0240, Nutrient Offset Payments Rule, Surface Water Protection Section, NC Division of Water Quality, January 2006. ○ Jordan Lake Rules Fiscal Analysis, http://portal.ncdenr.org/web/wq/ps/nps/jordanrules ○ Local government-provided information from: Durham, Durham County, Franklin County, Granville County, Orange County, Person County. ○ Moran, A. and W.F. Hunt, 2004. BMP Cost Estimate Study. Cooperative Extension Service, North Carolina State University, Raleigh, NC. ○ NAHB, 2009. Data from the National Association of Home Builders 2009 Builder Members' Census. See Appendix B. ○ NCDEM, 1996. Export Coefficients Revisited. NC Division of Environmental Management, Planning Branch. October 1996. 6pp. ○ NCDENR, 1992. Watershed Planning in the Albemarle-Pamlico Estuarine System. Annual Average Nutrient Budgets. Report No. 92-10. August 1992. ○ NCEEP, 2010. Presentation by NC EEP to NC Environmental Management Commission Requesting Approval to Take Nutrient Offset Rules to Public Comment, January 2010. http://portal.ncdenr.org/web/emc/agendas/2010/home. ○ NCEEP, 2010b. Economic Analysis for Proposed Amendment to 15A NCAC 2B .0240 and Establishment of 15A NCAC 02B .0274, the Nutrient Offset Payment Rule. Report to NC Office of State Budget and Management. Approved January 21, 2010. http://www.osbm.state.nc.us/ncosbm/economic_analysis/regulatory_analysis.shtm ○ NC Stormwater BMP Manual, July 2007, NC DWQ. http://portal.ncdenr.org/web/wq/ws/su/bmp-manual ○ Pate, Travis, 2009. Watershed Assessment in North Carolina: Building a Watershed Database with Population, Land Cover, and Impervious Cover Information. University of North Carolina, Chapel Hill, NC. ○ SBA, 2009. Small Business Profile, North Carolina. US Small Business Administration, Office of Advocacy. October 2009. ○ Tar-Pamlico Nutrient Export Method, Piedmont Version, 2004. http://portal.ncdenr.org/web/wq/ps/nps/tarpamstorm ○ Tetra Tech, 2005. Town of Cary Town Center Area Stormwater Management Plan Final Report. March 2005.

4-A. Regulated Parties: Developers

RP.0 Party Description (Developers)

Name of Party	Developers in the Falls Lake Watershed
Description	Local governments would implement programs 18 months after rule effective date. With an effective date of January 2011, local governments would implement new development permitting programs by mid 2012. Developers would begin to incur costs at that point, excepting projects that meet local vested rights determinations. Developers would incur capital, planning, and regulatory costs. Section 3.2 above describes the nature of net additional requirements facing developers. They would be required to meet nutrient export rate targets, using onsite structural BMPs or a combination of BMPs and approved off-site measures.
General Baseline	See Section 3.2 above.

RP.1 Annual Capital Costs/Savings (Developers):

(a) Cost Baseline	Section 3.2 above describes baseline conditions for developers.
(b) Description	This rule would require nutrient loading reduction to meet absolute loading rate targets and flow control for stormwater runoff. These requirements exceed controls needed to meet Phase II and Water Supply requirements in some cases, as described in Section 3.2 above. To meet these additional reduction needs, capital costs would involve land purchase, planning, construction of engineered stormwater BMPs, and regulatory transaction/compliance costs. Developers have the option to obtain load reductions offsite if needed to meet the rate targets once they reduce loads onsite by 50%. We include costs estimates for this scenario in the regulatory transaction category.

(c) Quantify ($)	Please see Table 2.4 above for fuller information. 2011 0 2012 $5.2 - 9.6 m 2013 $5.4 - 10.0 m 2014 $5.6 - 10.4 m 2015 $5.8 - 10.7 m 2016 $6.0 - $11.1 m 2017 $6.2 - $11.5 m 2018 $6.5 - $12.0 m 2019 $6.7 - $12.4 m 2020 $6.9 - $12.8 m Implementation year 25, 2035: $11.7 - $21.6 million NPV Stage I $36.2 - $66.9 m NPV Stage II $40.8 - $75.5 m

	NPV Stage I+II $77.0 - $142 m

(d) Quantification Method	We use the following steps (note that we use the same process in the state and federal entities stormwater calculations and the same concepts in the Existing Development Rule calculations): 1. We project acres of new development in 2013 as three types: county residential, municipal residential, and commercial/industrial/multifamily. 2. We determine annual N and P load reduction needs for each development type in lb/yr. 3. We calculate unit costs for a suite of BMPs, distribute the annual load reduction need across BMPs based on likely use proportions, determine the resulting number of each BMP needed, and equate BMP numbers to cost using the unit cost values. We use best estimate values and conservative values to provide a range. 4. To provide a low end estimate we determine the portions of load reductions that may be obtained offsite and convert them to cost using nutrient offset rates projected for the watershed by the NC Ecosystem Enhancement Program. We concurrently reduce the onsite reduction needs by the offsite load amounts and reduce the onsite costs accordingly. **Step 1 of 4: Acres per Year of New Development** ▪ We first projected average annual percent population growth rate for the analysis period. We used population data from the 2000 Decennial US Census and applied percent growth projections from the NC Office of State Budget and Management to project average percent growth. The database described in Pate, 2009 provided this information, which aggregated census blocks by USGS 14-digit hydrologic unit watersheds and distributed county growth projections across these census blocks to produce population projections for 14-digit HU's and all years of interest. Based on this we calculated average percent growth for the Falls watershed for the analysis period to be 1.69 %/yr. ▪ We obtained an estimate of development acres for 2013 by growing 2000 developed acres to 2013 values using the above growth rate, then calculating acres added in 2013. We obtained 2000 developed acres using acreages of developed land cover types from the Falls Lake Watershed Model, which we aggregated into three simpler development types – county residential, municipal residential, and commercial/industrial/multifamily - based on land cover descriptions after growing acres to 2013 values.

Table 2.5: Estimated Acres of Development in Falls Watershed, 2013

2013 Consolidated Development Type Acreages (Ac)

	County Residential	Municipal Residential	Commercial/ Industrial
Upper 5	33,701	8,859	4,831
Lower	17,133	3,820	906
Total	50,834	12,679	5,737

2013 New Development Acreage Increases (ac/yr)

	County Residential	Municipal Residential	Commercial/ Industrial
Upper 5	570	150	82
Lower	290	65	15
Total	860	215	97

Step 2 of 4: Pounds per Year Reduction Needed

For each nutrient we assigned each of the three development types a typical untreated unit-area loading rate in pounds per acre per year, quantified rate reductions achieved on a representative project by compliance with Phase II, Water Supply Watershed, and Neuse stormwater ordinances, and compared the result to this rule's loading rate target to calculate net additional lb/ac-yr reduction need, which we applied to the projected acres of development in 2013 to estimate reduction need as annual mass load, lb/yr, in 2013.

- To set unit-area loading rates, we relied on established, published values developed for the Albemarle-Pamlico region (NCDEM, 1996; NCDENR, 1992), supplemented by values estimated by the Tar-Pamlico export method, Piedmont Version, 2004. The latter is a tool developed to implement the same type of stormwater rule in the Tar-Pamlico River Basin. The Piedmont Version is appropriate for Falls Lake Watershed. Where these sources overlapped, they were very consistent. In using the Tar-Pamlico method, we chose lot sizes and pervious and impervious characteristics of a typical development within each of the three categories. We factored the absolute density ceiling of 70% impervious imposed by the WS-IV category of the WSW regulations into the commercial/industrial loading rates. While areas in the watershed under WS-II and WS-III regulations are limited to 30% and 50% impervious respectively, they comprise a minority of watershed area and we assume that zoning is generally designed to minimize development in these areas. Other facets of the existing regulations that influenced the rates we set are described in Section 3.2 under Developers' Baseline.

- As illustrated in Table 2.6 below, for each development type and nutrient we identified a percentage reduction in the loading rate that would be achieved by compliance with Phase II or WSW regulations, then an additional reduction that would occur based on compliance with Neuse stormwater requirements. Comparing the remainders to the loading rate targets in this rule yielded lb/ac/yr

	load reduction needs for each type and nutrient. ▪ As also shown in Table 2.6, we then applied the unit-area load reduction needs to acres of development estimated in Step 1 to obtain 2013 mass load reduction needs in lb/yr.

Table 2.6. Estimated N and P Loading Rate and Load Reduction Needs for Falls New Development

New Development Nitrogen Load Reduction Need Beyond Other Regulatory Requirements

	County Res	Muni Res	Comm / Ind	Total	Notes
	2.8	7.5	12.5		**Untreated Development Unit-Area Loading Rates (lb/ac/yr)**
					1) If > 4 lb/ac/yr (24% bua), subtract 33% (WS/PhII Treatment requirement)
1)	**2.80**	**5.03**	**8.38**		**WSW/PhII-Treated Unit-Area Loading Rates (lb/ac/yr)**
					2)If >3.6 lb/ac/yr, reduce to 3.6 (Neuse Stormwater requirement)
2)	2.8	3.600	3.600		**WSW/PhII/Neuse - Treated Unit-Area Load Rates (lb/ac/yr)**
					3) Subtract 2.2 lb/ac/yr (Falls loading rate target)
3)	**0.6**	**1.400**	**1.400**		**<Unit Area N Load Reduction Need (lb/ac/yr)**
					4) Multiply by New Development Annual Acres
4)	516	300	136	952	**2013 N Load Reduction Need (lb/yr)**

New Development Phosphorus Load Reduction Need Beyond Other Regulatory Requirements

	County Res	Muni Res	Comm/Ind	Total	Notes
	0.46	0.9	1.1		**Untreated Development Unit-Area Loading Rates (lb/ac/yr)**
					1) If > 0.6 lb/ac/yr (24% bua), subtract 38% (WS/PhII Treatment requirement)
1)	**0.46**	**0.56**	**0.68**		**WSW/PhII-Treated Unit-Area Loading Rates (lb/ac/yr)**
					2) If > 0.54lb/ac/yr, reduce to 0.54 (Neuse Stormwater requirement)
2)	0.46	0.54	0.54000		**WSW/PhII/Neuse - Treated Unit-Area Load Rates (lb/ac/yr)**
					3) Subtract 0.33 lb/ac/yr (Falls loading rate target)
3)	0.13	0.19	0.21000		**Unit-Area P Load Reduction Need (lb/ac/yr)**
					4) Multiply by New Development Annual Acres
4)	112	41	20	173	**2013 P Load Reduction Need (lb/yr)**

Quantification Method (cont'd)	**Step 3 of 4: Equating Pounds per Year Reduction to Cost** We calculate unit costs for a suite of BMPs, distribute annual load reduction need across BMPs based on likely use proportions, determine a resulting number of each BMP needed, and equate BMP numbers to cost using the unit cost values. We also ran a second set of all calculations – "conservative estimates" – using cost information provided by the local chapters of the NC Homebuilders' Association (HBA, 2010). Full calculations for the following steps are provided in Appendix B, which we performed for each of three development types and both nutrients, summing costs across development types for each nutrient: ▪ For each BMP we developed unit capital, planning, regulatory transaction and O&M cost values based on published, piedmont NC data where available (Hunt and Wossink, 2003; Moran and Hunt, 2004) and information from the

NC Stormwater BMP Manual otherwise, with other required assumptions as stated in the Notes section of Appendix B.

- Capital installation costs include land, labor, and materials.
- For each BMP we calculated unit annual load reduction. We applied N and P percent treatment efficiencies to the averaged input loading rate, and multiplied the result by the acres of drainage area being treated by that BMP type. Percent efficiencies were established under the Neuse and Tar-Pamlico stormwater rules and are included in the NC Stormwater BMP Manual. Drainage areas are available either in the BMP Manual or in publications from NCSU Dept of Biological and Agricultural Engineering.
- We then distributed the annual mass load reduction need across the BMPs based on likely use proportions. This yielded the number of each BMP required, which we translated to annual cost using the unit cost values. We set the likely BMP proportions for *both* the "most likely" and "conservative" calculations with input provided by the Durham/Orange chapter of the NC Homebuilders Association (HBA, 2010). See assumptions below for further explanation.
- Recognizing that a small fraction of all new development costs are incurred by local government public building projects, and that this development would have been included in the totals estimated here given the method we used for projecting new development, we estimated the local governments' fraction of capital, planning and regulatory costs separately and deducted it from the otherwise unadjusted totals. Values in the summary Table 2.4 reflect these adjustments. A description of the local government calculations is provided in the local government section of this chapter, and a table is provided in Appendix B detailing these calculations.
- As stated in General Assumptions, we found that meeting nitrogen targets required a greater cumulative number of BMPs than did the phosphorus targets. We inferred that phosphorus requirements are met through co-control at no added cost to the nitrogen costs. Values in Table 2.4 are those required to meet nitrogen targets.

Step 4 of 4: Run an Adjusted Cost Scenario Using the Offsite Reduction Option

We apply the rule's 50% onsite reduction requirement to the untreated loading rates for each development type and nutrient shown in Table 2.6. We compare these loading rates to those resulting from existing WSW, Phase II, and Neuse requirements. We then compare the lower rate value to the rule's loading rate targets of 2.2 lb N/ac/yr and 0.33 lb P/ac/yr. The difference in loading rate, applied to the 2013 acres of each development type, is the portion of 2013 load reduction that can potentially be obtained offsite.

We then apply nutrient offset rates projected by the NC Ecosystem Enhancement Program (EEP) for the Falls watershed to the load reduction needs for each nutrient, along with a multiplier of 30 for the number of years of reduction for which we currently require payment under this option, to yield total offsite cost for each nutrient. The EEP provided the following projected rates for Falls watershed in a presentation to the Environmental Management Commission in January 2010 (NC EEP, 2010) as part of a rulemaking process to refine their offset rates: $22/lb N, $140/lb P. As discussed by EEP staff, these rates assume that both N and P must be offset independently, making the offset costs for the two nutrients additive.

	Finally we deduct the offsite N load from the total N reduction need to yield the remaining onsite N reduction need. We carry the revised reduction need through the process described in step 3 for a reduced onsite cost for this scenario, which we combine with the offsite cost for a revised total cost. We chose to enter the offsite reduction costs in the Regulatory Transaction category. We found that for county residential development, for both N and P the 50% onsite requirement was more than sufficient to fully meet the rate target requirements, obviating any offsite need. For both municipal residential and commercial/industrial development types, for N we found that the Neuse 3.6 lb/ac/yr requirement was more stringent than the loading rates achieved by the 50% onsite requirement. Thus for these two development types the entire N reduction required under this rule could be achieved offsite. Results for P were split: for municipal residential, the 50% onsite requirement yielded a more stringent loading rate, 0.45 lb P/ac/yr, than the Neuse requirements, which we estimate to equate to 0.54 lb P/ac/yr. The result was that about two-thirds of the annual reduction requirement for this development type could be obtained offsite. For commercial/industrial development, the Neuse requirement was slightly more stringent than the .55 lb P/ac/yr rate resulting from the 50% onsite requirement, meaning that the entire P reduction need under this rule could be obtained offsite. Table 2.7 below illustrates these calculations.

Table 2.7: Calculation of Offsite Load Reductions Available and Associated Cost

Nitrogen Offsite Partial Reduction

County Resid'l	Muni Resid'l	Comm / Industrial		
2.8	7.5	12.5		Untreated lb N/ac/yr
1.4	3.75	6.25		Loading rate after 50% onsite Falls reduction
2.2	3.6	3.6		Lower loading rate, 50% vs Neuse Stormwater (lb/ac/yr)
-	300	136		Offsite load reduction available, 2013 (lb/yr)
$ -	$198,248	$ 89,703		Cost for 2013 offsite load reduction ($/yr) @ $22/lb

Phosphorus Offsite Partial Reduction

0.46	0.9	1.1		Untreated lb/ac/yr
0.23	0.45	0.55		Loading rate after 50% onsite Falls reduction
0.33	0.45	0.54		Lower loading rate, 50% vs Neuse Stormwater (lb/ac/yr)
-	26	20		Offsite reduction available, 2013 (lb/yr)
$ -	$108,135	$ 85,626		Cost for 2013 offsite load reduction ($/yr) @ $140/lb

N+P Offsite			**Total**	
$ -	$306,383	$175,329	$481,712	Total cost 2013 offsite load reduction (sum of N+P)

Remaining Onsite N Load Reduction Need

516	-	-	Remaining 2013 Onsite N Load Reduc Need (lb/yr)

(e) Assumptions	▪ We assume BMP lifespans of 30 years. While there is relatively little real-world data on the nature of long-term BMP maintenance, repair, or replacement, expert input from Dr. William Hunt with North Carolina State University is that lifespans vary with BMP type and as a function of maintenance performed; long-term needs are likely to involve periodic minor repairs as opposed to wholesale replacement provided that BMPs are regularly maintained. ▪ We assumed input loading rates to BMPs to be the PhII/WSW-treated rates in Table 2.6. We assumed each development type would use offsite measures to meet remaining Neuse reduction requirements given that each meets its offsite threshold (6 lb N/ac/yr residential or 10 lb N/ac/yr commercial/industrial) with the first, WSW/PhII BMP. ▪ We set proportions of BMPs based on input provided by the Durham/Orange County Homebuilders' Association (HBA, 2010). This provides ***higher*** cost estimates than would BMP distributions based simply on relative cost-effectiveness of BMPs. We recognize that a developer considers factors in addition to cost-effectiveness in choosing BMPs. However, we also recognize that developers do not now have a full understanding of relative implementation costs for BMP options under this rule and cannot be expected to accurately predict their future choices now. Thus actual costs may ultimately be less than predicted here. ▪ We used different per-acre land costs for each development type. Municipal residential and commercial/industrial values were provided by the Raleigh/Wake County chapter of the NC Homebuilders' Association from development sites in Cary and Raleigh respectively (HBA, 2010). County residential was a rural land value provided by NCDOT for the Jordan nutrient rules fiscal analysis in 2007. We inflated this value to 2012 using the NC Consumer Price Index, which yielded a factor of 1.10 for the 5-year span. Values in $/ac in 2012 are: county residential $30,133; municipal residential $63,300; commercial/industrial $230,000. ▪ We assumed Durham's permitting fee of $3,500/BMP to be a reasonable estimate of regulatory transaction costs, recognizing that other local governments may charge different or no permitting fees. Given that we used a $17,300/BMP value in the conservative estimate based on additional cost considerations, we believe that the resulting cost ranges provide a robust overall estimate. ▪ We assumed for the low end estimate that developers would choose the offsite option after satisfying the minimum onsite requirement in all cases based on the recognition that EEP credits are a fraction of the onsite cost. We also assumed that such credits from EEP or a private bank would be available in all cases. Private banks will likely be the available option instead of EEP (recent legislation requires developers to use private bank credits if they are available rather than EEP credits), but lacking estimates from private banks, we assume EEP's projected rates are reasonable surrogates for what private banks will charge.
(f) Data Sources	See References following General Assumptions above.

RP.2 Annual Operating Costs/Savings (AOC/S) (Developers):

(a) Cost Baseline	Section 3.2 above describes baseline conditions for developers.
(b) Description	BMPs require maintenance in order to continue to work effectively. Examples of maintenance include establishing desirable vegetation, removing undesirable species, removing accumulated sediment, clearing and repairing control structures, repairing erosion, and other activities. However, developers would not be responsible for maintenance. It would become the responsibility of property owners, thus we discuss O&M in that section of the chapter.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A.
(f) Data Sources	N/A

RP.3 Annual Planning Costs/Savings (APC/S) (Developers):

(a) Cost Baseline	Section 3.2 above describes baseline conditions for developers.
(b) Description	Planning costs to developers would include activities such as stormwater routing design and runoff calculations, BMP selection, placement, sizing calculations, water quality and quantity drawdown design. While all of this is required to meet Phase II, WSW and Neuse regulations, this rule would impose additional complexity in some cases.

(c) Quantify $	Please see Table 2.4 above for fuller information. 2011 $0 2012 $1.2 - $2.1 m 2013 $1.2 $2.2 m 2014 $1.3 - $2.3 m 2015 $1.3 - $2.4 m 2016 $1.4 – $2.5 m 2017 $1.4 - $2.6 m 2018 $1.5 - $2.7 m 2019 $1.5 - $2.7 m 2020 $1.6 - $2.8 m Year 25, 2035: $2.7 - $4.8 million. NPV Stage I $8.3 - $14.9 m NPV Stage II $9.4 - $16.8 m NPV Stage I+II $17.7 - $31.6 m

(d) Quantification Method	We estimated planning costs using a unit cost approach at 25% - 30% of BMP installation costs, varying for each BMP as illustrated in the following table. Thus annual planning costs compound at the annual growth rate of 1.7% and the rate of inflation.

Table 2.8: Planning Costs to Developers by BMP Type

BMP	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Per-BMP Planning Costs ($/BMP)
Stormwater Wetland	4.5	0.10	$7,977	$1,994 - $21,000
Bioretention	0.9	0.02	$5,590	$1,398 - $69,400
Wet Detention	8.0	0.14	$56,256	$14,064 - $16,877
Extended Dry Det.	8.0	0.14	$56,256	$14,064 - $16,877
Grassed Swale	1.0	0.01	$250	$63 - $100
Filter Strip/Level Spreader	2.5	0.29	$7,575	$1,894 - $2,273
Infiltration Devices	2.5	0.05	$8,800	$2,200 - $2,640
Buffer w/Level Spreader	2.3	0.46	$357	$89 - $107
Sand Filter	1.5	0.03	$70,084	$17,521 - $21,025

(e) Assumptions	We assumed planning costs at 25% to 30% of construction costs. We used three sources. Planning costs used by NC EEP for 2006 revisions to the Division's Offset Payments Rule (Hunt, 2006) were 18-47% of construction cost, with 24% as median value. Support calculations for the Cary Stormwater Management Plan (Tetra Tech, 2005) estimate design costs as 25% of construction costs. Dr. William Hunt with North Carolina State University provided expert input that planning costs vary with BMP type and are subject to economies of scale, but for greenfield development 30% is a good value. We used 25% in our "most likely" estimate and 30% in our "conservative" estimate.
(f) Data Sources	See References following General Assumptions above.

RP.4 Regulatory Transaction Costs/Savings (RTC/S) (Developers):

(a) Cost Baseline	Section 3.2 above describes baseline conditions for developers.
(b) Description	Developers would incur regulatory transaction costs associated with obtaining stormwater permits from local governments. With some local governments, they may incur *no* significant additional regulatory costs beyond those they face under Phase II, WSW and Neuse regulations; however to be conservative we do attribute new costs on a per BMP basis applied to all BMPs. We also include in this category costs generated by use of the offsite offset option.

(c) Quantify $	Please see Table 2.4 above for fuller information. $3,500 - $17,300 per BMP permitting cost for the low-end scenario, plus $660/lb N and $4,200/lb P for offsite reductions where available 2011 $0 2012 $.97 - $2.8 m 2013 $1.0 - $2.9 m 2014 $1.04 - $3.0 m 2015 $1.08 - $3.1 m 2016 $1.12 - $3.3 m 2017 $1.16 - $3.4 m 2018 $1.20 - $3.5 m 2019 $1.24 - $3.6 m 2020 $1.29 - $3.8 m Implementation year 25: 2035: $2.2 - $5.9 million NPV Stage I $6.7 - $19.6 m NPV Stage II $7.6 - $22.1 m NPV Stage I+II $14.3 - $41.7 m
(d) Quantification Method	For the low end estimate we used $3,500/BMP across all BMPs based on input from City of Durham stormwater staff that they charge this as a permitting fee to cover their costs. Since we attribute the payment of this cost to the developer throughout the watershed, we report zero cost to local governments for permitting in the Local Government section of the chapter. For the "conservative" calculation, we used a regulatory transaction cost of $17,300/BMP based on this fee plus additional costs identified by the Homebuilders as including As-Built surveys, inspection, and turnover (HBA, 2010).
(e) Assumptions	We assume that this range of costs covers developers' permitting costs, which will vary but may include varying permit fees as well as consultant fees for completing steps of local regulatory processes from obtaining permits to certificates of occupancy.
(f) Data Sources	▪ Personal Communication with John Cox, City of Durham Stormwater Services. ▪ Raleigh/Wake County chapter of NC Homebuilders' Association – see reference above and Appendix B for full information.

RP.5 Other Costs/Savings (OtC/S) (Developers)

(a) Cost Baseline	Section 3.2 above describes baseline conditions for developers.
(b) Description	Developers may generate trading potential in over-treating for one nutrient or the other, depending on project specifics. Through the trading rule, Rule .0282, they could potentially sell reduction credits to others in need. Because our calculations estimate that the treatment requirements of the two nutrients are comparatively close, given the uncertainties associated with our estimates and the expected variation in comparative N:P requirements from site to site we assume no monetary trading benefit from the excess phosphorus control that we project. This conservative approach may ***overestimate*** the cost of complying with the rule given that the other sources are projected to be in need of phosphorus credit.

(b) Description (continued)	On the other hand, the imposition of this rule may depress demand for development in this watershed or lead developers to increase lot sizes to enable compliance, both of which could lead to diminished profits. Given the speculative nature of these considerations, we did not attempt to quantify these effects, but this may ***underestimate*** the cost of complying with this rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

Property Owners

RP.1 Capital Costs/Savings (AOC/S) (Property Owners):

(a) Cost Baseline	The price that property buyers pay for real estate includes costs passed on by developers for rule compliance with Phase II, WSW and Neuse regulations as described in Section 3.2.
(b) Description	To the extent that this rule results in additional BMPs or offsite reduction measures beyond BMP requirements of the other stormwater regulations, the price property buyers pay for real estate includes costs passed on by developers for compliance with this rule. However since those costs are already included in this chapter as developer costs they are not repeated here.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A.
(f) Data Sources	N/A

RP.2 Annual Operating Costs/Savings (AOC/S) (Property Owners):

(a) Cost Baseline	In most cases, property owners would inherit long-term operation and maintenance responsibilities for stormwater BMPs from developers under Phase II, WSW and Neuse regulations as described in Section 3.2. This would include conducting inspections of BMPs and performing upkeep at frequencies required by local governments, along with submitting inspection reports. Inspection/report frequencies are typically at least annual. Upkeep actions vary by BMP but often include removal of accumulated sediment, debris removal from control structures, repair of eroded areas, and vegetation management including mowing of grassed areas.
(b) Description	To the extent that this rule requires additional BMPs beyond those imposed by Phase II, WSW and Neuse regulations as described above, property owners would face additional maintenance costs annually for the lifetime of the development. We quantify O&M costs for the BMPs beyond those required under those regulations.

(c) Quantify $	Unit annual O&M costs ranged from $200 - $1,100/BMP. Total annual costs: 2011 0 2012 $88 - $110 k 2013 $179 - 210 k 2014 $274 - 330 k 2015 $373 - 450 k 2016 $475 - 570 k 2017 $580 - $690 k 2018 $690 - $820 k 2019 $800 - $960 k 2020 $920 k - $1.1 m Year 25, 2035: $2.8 - $3.8 million/yr. NPV Stage I $2.7 - $3.2 m NPV Stage II $8.7 - $10.4 m NPV Stage I+II $11.4 - $13.6 m
(d) Quantification Method	Unit O&M costs are specific to each BMP and also vary in relationship to BMP footprint area (or less directly, drainage area). We used formulas that characterize this relationship for each type of BMP provided in Moran and Hunt, 2004 or based on data provided in the NC Stormwater BMP Manual. We adjusted all formulas for inflation from 2004 to 2012 values for the implementation year one calculation using the NC Consumer Price Index, which yielded a factor of 1.19. As with all calculations, we then inflated year one values to all future years with year-specific projections from the same index. Watershed-wide, O&M costs compound annually with the addition of BMPs to the watershed. We estimated the number of new BMPs as growing from 187 to 275 BMPs/yr from 2012 to 2035 respectively.
(e) Assumptions	See the Notes section of Appendix B for BMP-specific information.
(f) Data Sources	See References following the General Assumptions above.

RP.3 Annual Planning Costs/Savings (APC/S) (Property Owners):

(a) Cost Baseline	Property owners do not incur planning costs under Phase II, WSW and Neuse regulations.
(b) Description	We do not anticipate planning costs to property owners.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.4 Regulatory Transaction Costs/Savings (RTC/S) (Property Owners):

(a) Cost Baseline	Property owners do not incur planning costs under Phase II, WSW and Neuse regulations.
(b) Description	We do not anticipate regulatory costs to property owners.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A

Local Governments

While local governments are regulated parties under this rule, the nature of their compliance is primarily to administer programs that impose the substantive requirements of the rule on others. Thus the following costs are largely grouped using categories for implementing agencies. However, since local governments also conduct building activities, we estimate their costs of complying with the substantive requirements of the rule, and provide those results following their administrative costs.

4-B. Implementing Agencies:

IA.0 Party Description (Local governments)

Name of Party	**Local governments**
Description	All counties and incorporated municipalities in the watershed would be required to implement the provisions of this rule, which would involve enacting and implementing stormwater ordinances to control nutrient loading. The 14 local governments are the 6 counties of Durham, Franklin, Granville, Orange, Person, and Wake, and the following 8 municipalities: Durham, Butner, Creedmoor, Hillsborough, Raleigh, Roxboro, Stem, and Wake Forest.
General Baseline	See Table 2.1 and the Local Government Baseline discussion in Section 3.2 above. Except for Stem, all municipalities in the watershed are or will be subject to Phase II requirements and either are currently implementing Phase II programs or will implement them beginning 2012. All municipalities except Hillsborough fall within water supply watersheds and implement WSW stormwater programs. Lastly, the four fastest growing municipalities in the watershed – Durham, Raleigh, Wake Forest and Hillsborough – implement the Neuse stormwater rule. Altogether, we do not expect that Falls municipalities will incur significant additional costs to implement this rule. All counties in the watershed contain water supply watershed areas and administer WSW stormwater programs (while all counties in the watershed except Granville and Person are considered "tipped in" under Phase II, this will subject new development outside of water supply watersheds to Phase II permitting by the Division and will not require county resources). The three fastest growing counties – Durham, Wake, and Orange implement the Neuse regulation. Much new development activity in counties is likely to fall within municipalities' planning jurisdictions. Thus, counties should not incur significant additional costs to implement this rule either.

Assumptions	N/A
Data Sources	N/A

IA.1 Regulatory Development Costs/Savings (RDC/S) (Local governments)

(a) Cost Baseline	The larger local governments – at least Durham, Raleigh, Wake County, Durham County, Orange County – have stormwater staff or other staff who draft and amend ordinances and take them through approval processes as part of their ongoing job responsibilities.
(b) Description	Local governments would draft and adopt ordinances to implement the nutrient loading and flow rate requirements of this rule. The Division will provide local governments with model ordinances developed for Jordan rules compliance.
(c) Quantify $	$166,000 Year 1 only. Note that this cost is part of the total local government cost presented in Table 2.4 above.
(d) Quantification Method	We made the conservative assumption that all 14 local governments would contract 120 hours of work at $100/hr to prepare and take ordinances through local approval processes. Assuming all costs are direct, there is no need to estimate a fraction as opportunity costs. We did so recognizing significant variability in the approval processes and the resources available internally to develop regulations. We did not obtain input from local governments on this cost. Other factors could influence this cost. One scenario could involve sharing of ordinance text among local governments with similar ordinance frameworks, which could significantly reduce total cost from the approach assumed here.
(e) Assumptions	▪ As noted in the description above, we assume that Division staff will provide a model ordinance, reducing local time demands.
(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings (MRC/S) (Local governments)

(a) Cost Baseline	Virtually all local governments have or will have stormwater programs to implement Water Supply, all municipalities will have Phase II programs, and three counties and four municipalities implement Neuse programs.
(b) Description	This rule would not impose specific monitoring requirements outside of inspections, which are covered separately below. Recordkeeping would be needed to track development projects and enforcement cases, and to develop and submit annual reports to the Division.
(c) Quantify $	$56,000 in Year 1, then $28,000 year annually
(d) Quantification Method	The City of Durham estimated a one-time initial cost (to structure the content of information that would be collected from permitted projects for tracking and reporting purposes) of $2,000 plus $12,000/yr to monitor inspection reports, enforce, and develop annual reports. We multiplied Durham's one-time cost by the number of local governments in the watershed and Durham's annual cost by a factor of 2.33, our estimated ratio of all watershed development to Durham development, based on the assumption that new development would occur in the same proportions as it currently exists across local governments and that monitoring costs would follow accordingly.

(e) Assumptions	N/A
(f) Data Sources	City of Durham Stormwater Services.

IA.3 Permitting Costs and Savings (PC/S) (Local governments)

(a) Cost Baseline	Virtually all local governments have or will have stormwater programs to implement Water Supply, all municipalities will have Phase II programs, and three counties and four municipalities implement Neuse programs.
(b) Description	As discussed in the Developers section, we assume that local governments will charge permitting fees to cover their costs, and we estimate permitting costs in that section and include them in developers' totals. Thus, net permitting costs for local governments are given as zero.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	We assume that developers pay these costs to local governments in the form of permit fees, so we account for them in that section. Also, we assume that the fees would exactly offset all costs related to permitting.
(f) Data Sources	N/A

IA.4 Inspection and, Enforcement Costs/Savings (IEC/S) (Local governments)

(a) Cost Baseline	Virtually all local governments have or will have stormwater programs to implement Water Supply, all municipalities will have Phase II programs, and three counties and four municipalities implement Neuse programs.
(b) Description	Local governments inspect new development sites for compliance with permitted construction designs and audit a portion of all existing sites for reporting accuracy.
(c) Quantify $	$360 per new BMP/yr Year 1 $67,000 Year 25 $99,000
(d) Quantification Method	The number of new BMPs ranges from 187 in year 1 to 275 in year 25. The City of Durham provided the per BMP estimate of $360.
(e) Assumptions	• We assumed no increases in staff over time to audit the growing number of existing developed sites. • We assume the unit cost includes staff time and associated travel costs to perform inspections.
(f) Data Sources	City of Durham Stormwater Services.

RP.1 Development Compliance Costs (Local governments)

(a) Cost Baseline	Local governments conduct building activities that are required to comply with the substantive requirements of the rule in addition to administering the requirements of the rule on private parties. As with developers, their building activities must currently meet WSW, Phase II and Neuse stormwater requirements.
(b) Description	Local government building projects differ in nature from the types we have identified for developers, but we did not attempt to characterize those activities. Instead we assumed them to be similar in loading character to municipal residential and commercial/industrial development. We estimated the fraction of all new development that would be conducted by local governments and used that fraction of the developer cost totals as those associated with local government building.
(c) Quantify $	Year Low High 2011 $0 $0 2012 $15 k $172 k 2013 $16 k $180 k 2014 $16 k $187 k 2015 $17 k $195 k 2016 $18 k $203 k 2017 $18 k $212 k 2018 $19 k $220 k 2019 $20 k $230 k 2020 $20 k $238 k NPV Stage I+II: $230 k - $2.70 m
(d) Quantification Method	We used the fraction of all offset payments made to the NC Ecosystem Enhancement Program, 2007-2009, as an estimator of the portion of all new development that is conducted by local governments (NC EEP, 2010b). That fraction is 3%. We applied this fraction to the costs we estimated for municipal residential and commercial/industrial development, as the development types closest in type and loading nature to local government projects. Thus the low end estimate above reflects the use of offset purchases to meet the great majority of loading requirements, while the high-end estimate reflects exclusive use of onsite treatment estimated with conservative values, as described in the developers' sections above. Values for years beyond year one are increased by the growth rate used throughout, 1.69%/yr, and inflated using the NC CPI also as done throughout. The values above reflect the sum of capital, planning, regulatory transaction, and operation and maintenance.
(e) Assumptions	•
(f) Data Sources	See the Data Sources section at the beginning of this chapter.

State Government

IA.0 Party Description (Division of Water Quality)

Name of Party	Division of Water Quality
Description	The Division would develop and provide guidance for local program development, accounting methods and expectations, review and approve local program proposals, including ordinances, provide guidance to implementing local governments, approve nutrient offset projects, review annual implementation reports submitted by local governments, and perform compliance oversight on local programs. This may involve staff of the NPS Planning Unit, Stormwater Permitting Unit, Wetlands/401 Unit, and the Raleigh Regional Office.
General Baseline	The Division oversees local water supply watershed programs in the watershed, which include both stormwater permitting and riparian setbacks for new development. The Division will soon implement Phase II permitting for post-construction stormwater in most counties. The Division oversees compliance with Neuse stormwater rule requirements, including approval of nutrient offset projects, review of annual reports and provision of guidance to local governments.
Assumptions	N/A
Data Sources	N/A

IA.1 Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff perform a variety of the types of activities involved in developing and implementing these nutrient rules. They develop water quality models; develop, take through rulemaking, and coordinate implementation of nutrient strategies; oversee stormwater programs; approve nutrient offset activities.
(b) Description	Rule development involves staff time to: research rule components; plan and coordinate the rulemaking process; develop and revise rule language; research and document fiscal impacts; conduct/participate in stakeholder meetings; plan and conduct public workshops/meetings/hearings; present information to the Commission and agencies; file and process rules and associated documents. Beyond the rulemaking process, staff also conducts activities to support implementation that do not fit well under any of the categories below. These activities include developing program guidance and accounting methods for local programs and guiding implementation.
(c) Quantify $	$670,000 opportunity cost, all rules, over the 3.5 years preceding effective date, with the bulk of the cost in year one. See Appendix B for details.
(d) Quantification Method	This cost represents an **opportunity** cost to the Division. Tasks would be integrated into existing workloads. Since many staff work on all of the rules in the strategy, this estimate represents the sum of all DWQ staff time to develop **all rules** of the Falls nutrient strategy and take them through the rulemaking process. This estimate reflects the work of one primary staffer, their supervisor, and as many as half a dozen other staff over a total time span of approximately 3.5 years. Activity peaks with as many as 4 FTE's for a number of months.
(e) Assumptions	To estimate total FTE costs, we multiplied salaries for the positions involved by a factor of 1.4 based on budgeting information for other positions.

(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings (MRC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff perform a variety of the types of activities involved in developing and implementing these nutrient rules. They develop water quality models; develop, take through rulemaking, and coordinate implementation of nutrient strategies; oversee stormwater programs; approve nutrient offset activities.
(b) Description	For the first 4 or 5 years, implementation of **all rules of the strategy** will occupy more than half of one primary staff person's time, a smaller fraction of their supervisor's, and very small overall fractions of several other staffs' time. Beyond that point, **the strategy** will require approximately one-third of the primary staff person's time and cumulatively about .5 FTE from all other staff.
(c) Quantify $	$104,000 - $110,000/yr for years 1-5 $66,000/yr for years 6-25 in 2010 dollars; with inflation grows to $105,000 by year 25.
(d) Quantification Method	This cost represents an **opportunity** cost to the Division. Tasks would be integrated into existing workloads. This estimate represents the sum of all DWQ staff time to implement **all rules** of the Falls nutrient strategy.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.3 Permitting Costs and Savings (PC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff perform a variety of the types of activities involved in developing and implementing these nutrient rules. They develop water quality models; develop, take through rulemaking, and coordinate implementation of nutrient strategies; oversee stormwater programs; approve nutrient offset activities.
(b) Description	The Division will not issue permits as part of implementation but will oversee local permitting programs. The opportunity cost for doing so is included in the estimate provided in the Monitoring & Recordkeeping section above.
(c) Quantify $	$0
(d) Quantif. Method	See Monitoring & Recordkeeping section above.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.4 Inspection and Enforcement Costs/Savings (IEC/S) (Division of Water Quality)

(a) Cost Baseline	Division staff perform a variety of the types of activities involved in developing and implementing these nutrient rules. They develop water quality models; develop, take through rulemaking, and coordinate implementation of nutrient strategies; oversee stormwater programs; approve nutrient offset activities.
(b) Description	The Division will perform compliance oversight on local programs, which may include occasional field inspections in addition to visits to local offices. The opportunity cost for doing so is included in the estimate provided in the Monitoring & Recordkeeping section above.

(c) Quantify $	$0
(d) Quantif. Method	See Monitoring & Recordkeeping section above.
(e) Assumptions	N/A
(f) Data Sources	N/A

Section 5: Risk and Uncertainty

Of the set of rules comprising the strategy, this rule addresses the area of regulation with perhaps the least uncertainty. Stormwater runoff control on greenfield development is a fairly well-developed area of regulation, nutrient accounting methods are established, loading targets appear achievable based on current knowledge, these targets represent the strategy goals and are applied and presumably achieved on an incremental, project basis, and we assume that this process will continue throughout the analysis period. While this subject may involve the least uncertainty of the group, substantial uncertainties do exist, and projecting any economic activity 25 years into the future necessarily entails great uncertainty. Uncertainties apparent to us at this point include the following.

Actual growth and local growth management/land use planning: We did not attempt to quantify the uncertainty surrounding state growth projections for the watershed or project the influence that local land use controls or future changes in those controls may have on development in the watershed. Growth projections are subject to a range of economic and other influences operating at different scales. For example, in addition to local land use plans, a fundamental factor controlling growth at the local level is the availability of potable water. Another is landowner willingness to sell holdings for development. The potential for other state and federal regulatory changes is another factor. Local land use plans may constrain growth, and these plans also evolve over time as do trends in zoning decisions. These and a host of other factors could combine in any number of directions over 25 years. As a simple check on growth potential, our projection of development through 2035 would amount to approximately 33,000 acres added to an estimated 2012 total of approximately 69,000 acres. Nominally developable watershed area as of 2012 should total roughly 385,000 acres, suggesting that our projected growth may not be constrained by land availability even after a range of factors reducing the nominal acreage are taken into account. Nevertheless, future actual growth in the watershed involves sizable uncertainty.

Compliance Accounting: We expect current knowledge and technical tools for nutrient load accounting as applied to the rule to improve over time. For this analysis we used the Tar-Pamlico load estimation method. The Division is currently contracted with stormwater experts at North Carolina State University to develop a load accounting method for implementation of the Jordan New Development stormwater rule. That method, currently in draft form, is the most likely tool to be used for compliance accounting under this rule from the initiation of programs forward. The method incorporates knowledge that was not available when the Tar-Pamlico method was developed and that will refine loading estimates over that method. The draft method or some adjustment based on it could not be used in this analysis, but we assume that compliance requirements for this rule will vary from the estimates made in this analysis. The direction and magnitude are currently unknown, but could certainly be significant over a span of years.

It is likely that further refinements will be made to the accounting tool at points in the future. Such refinements could have significant impact on the character of new development and its costs. An element of new development not addressed in this rule as proposed nor in current or draft accounting tools is the potential nutrient loading from septic systems. Science quantifying the nature of such loading is not currently adequate to account for contributions that may be made by this source. While current science indicates that significant phosphorus loading from properly functioning septic systems to surface waters is unlikely, there may be nitrogen loading at quantifiable levels, and the character of loading of both nutrients under malfunctioning conditions requires greater substantiation. As a technical foundation becomes adequate to incorporate into an accounting method, it could influence developers' project decisions and modify development costs.

As research builds the knowledge base on nutrient loading impacts of new development, this rule may be modified over time to reflect that improved knowledge. For example, research may determine that hydrologic impacts of new development result in decreased instream nutrient removal or increases in nutrient loading from destabilized streambanks. Changes to rule requirements would affect the costs of new development in ways not currently known, which adds another element of uncertainty to this analysis.

Offsite reduction options: The trend in availability of offsite load reduction options is difficult to predict, but we expect the current, least costly option of riparian buffer restoration to diminish with time as agriculture increasingly utilizes this practice to meet its own rule requirements. Offsite options are thus likely to become increasingly expensive, but the timing and scale of costs is another element of uncertainty.

Chilling Effect: The potential exists for the added costs to developers associated with this rule to have the effect of driving development to less costly areas of the state, and to decrease the profits of development conducted in the watershed. These in turn would likely have the effect of reducing tax revenues to Falls local governments, as well as resulting in some amount of job loss in the local construction industry and costs or job loss to local government.

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Chapter 3: Stormwater Management for Existing Development

Step 1: Basic Information

1.1 Rule Reference No.	.0266
1.2 Analyst (Name and Title)	Rich Gannon, Environmental Supervisor
1.3 Office (Your Organizational Location)	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27604
1.4 Your Phone	(919) 733-5083 x, x356
1.5 Comments on Agency Contact	Mike Randall Division of Water Quality, Stormwater Unit NPDES Phase II Stormwater Information
1.6 Title of the Proposed Rule	Falls Lake Nutrient Strategy: Stormwater Management for Existing Development
1.7 Citation	15A NCAC 2B .0266
1.8 Brief Description of the Proposed Rule	The proposed rule would require all municipalities and counties in each subwatershed to achieve and sustain mass loading reductions from existing developed lands that equate to the strategy's percentage goals for each subwatershed as applied to developed lands.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint.

Watershed modeling estimates that nonpoint sources make up over half of all nitrogen inputs to Falls Reservoir, and two-thirds of phosphorus inputs. Of nonpoint sources, developed land uses are estimated to contribute about 38% of nitrogen and 21% of phosphorus inputs to the lake.

3.2 How does the Proposed Rule Change Behavior?

This rule would require all local governments in the Falls Lake Reservoir watershed to develop and implement programs to achieve sustained nutrient mass loading reductions from existing developed lands in the watershed toward specific, quantified reduction goals. No such requirements currently exist in the watershed. Local governments would seek opportunities to implement management practices on developed private and public lands that reduce nutrient inputs to streams in their jurisdictions indefinitely. These practices could include activities such as installation of stormwater BMPs where runoff is currently untreated, increased street sweeping, restrictions or increased education on fertilizer use, connection of individual residential wastewater disposal systems to improved means of wastewater treatment, elimination of illicit discharges to the stormwater system or of wastewater collection system discharges, or requirements to achieve greater treatment of stormwater on new development. Local governments would be responsible for ensuring that reductions are sustained long-term. This would include maintaining installed structural management practices. Unit of local governments would estimate and track loading reductions over time.

Local governments would develop plans in which they would propose rates of implementation for load-reducing activities toward existing development reduction goals. Timeframes are expected to be long-term. Local governments would begin to implement load-reducing activities in the third year after rule effective date, at which time they would begin to incur significant costs.

Table 3.1: Existing Development Rule Implementation Timeline

Assumed Date*	Elapsed Time from Eff. Date	Action
July 2013	2 ½ yrs	EMC approves model program including accounting
January 2014	3 yrs	LG's submit programs and begin implementation
March 2015	4 yrs 2 mo	EMC approves local programs
June 2015	4 yrs 5 mo	LG's revise implementation per approved programs
June 2016, and every June	5 yrs 5 mo + annually	LG's submit annual progress reports to Division
January 2021, 2026, 2031, 2036	10, 15, 20, 25 yrs	LG's submit and start implementing Stage II programs or revised Stage II programs

*** Based on January 2011 effective date and earliest completion date of each step.**

Step 4: Identify Impacts

4-A. Regulated Parties

RP.0 Party Description (Local Governments)

Name of Party	All local governments in the Falls Lake watershed.
Description	The rule would apply to all six counties with more than nominal land area in the watershed. These are: Durham, Franklin, Granville, Orange, Person, and Wake. The rule would also apply to all eight incorporated municipalities with land area in the watershed including Butner, Creedmoor, Durham, Hillsborough, Raleigh, Roxboro, Stem and Wake Forest.

General Baseline	Local governments in the watershed are not currently required to reduce nutrient loading from existing developed lands. All local governments, however, require stormwater controls on development over certain intensities under one or more of the following mandates: Water Supply Watershed protection, Phase II NPDES stormwater, Neuse stormwater (see New Development chapter, Tables 3.1 and 3.2). All new development controls installed since the lake's baseline year, 2006, serve as reduction credit relative to an untreated runoff condition toward a local government's Existing Development reduction needs.
General Findings	Table 3.2 below provides a summary of projected costs for this rule. The directly affected party is local governments, with relatively minor opportunity costs to state government. While the proposed rule is not anticipated to have direct effects on small businesses given that the directly regulated parties are the watershed's local governments, small businesses such as engineering firms and associated consultants stand to gain significantly through the process of earning contracts to carry out the large amounts of work that will be required by the rule. At the same time, potential also exists for the rule to ultimately, indirectly affect the majority of, if not all, small businesses in the watershed as local governments seek to involve them in load-reducing activities either through siting retrofits on commercial property or increasing utility fees to fund load reduction activities.

Table 3.2: Summary of Costs to Affected Parties, Existing Development Rule

Year	Private	Local Government				State Gov't	Fed Gov't	Total
		Planning	Capital	O&M	Total			
2011	$ -	< $ 6.4 m	< $ 22.1 m	< $ 190 k	< $ 28.8 m	$ -	$ -	< $ 28.8 m
2012	$ -	< $ 6.6 m	< $ 22.6 m	< $ 390 k	< $ 29.6 m	$ -	$ -	< $ 29.6 m
2013	$ -	< $ 6.7 m	< $ 23.1 m	< $ 600 k	< $ 30.4 m	$ -	$ -	< $30.4 m
2014	$ -	< $ 6.8 m	< $ 23.6 m	< $ 820 k	< $ 31.2 m	$ -	$ -	< $ 31.2 m
2015	$ -	< $ 7.0 m	< $ 24.0 m	< $ 1.0 m	< $ 32.0 m	$ -	$ -	< $ 32.0 m
2016	$ -	< $ 7.1 m	< $ 24.5 m	< $ 1.3 m	< $ 32.9 m	$ -	$ -	< $ 32.9 m
2017	$ -	< $ 7.3 m	< $ 25.0 m	< $ 1.5 m	< $ 33.8 m	$ -	$ -	< $ 33.8 m
2018	$ -	< $ 7.4 m	< $ 25.5 m	< $ 1.8 m	< $ 34.6 m	$ -	$ -	< $ 34.6 m
2019	$ -	< $ 7.5 m	< $ 25.9 m	< $ 2.0 m	< $ 35.5 m	$ -	$ -	< $ 35.5 m
2020	$ -	< $ 7.6 m	< $ 26.4 m	< $ 2.3 m	< $ 36.3 m	$ -	$ -	< $ 36.3 m

Projection of costs for points 10 years and further into the future involves a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.

NPV Stg I	**$ -**	**< $ 48.9 m**	**< $ 169 m**	**< $ 7.5 m**	**< $ 225 m**	**$ -**	**$ -**	**< $ 225 m**
NPV Stg II	**$ -**	**< $112 m**	**< $ 403 m**	**< $35.8 m**	**< $ 551 m**	**$ -**	**$ -**	**< $ 551 m**
NPV Stg I+II	**$ -**	**< $161 m**	**< $ 571 m**	**< $43.3 m**	**< $ 776 m**	**$ -**	**$ -**	**< $ 776 m**

Assumptions	Major assumptions for this rule include the following: • In these estimates we assume the most conservative, ***highest-cost*** means of achieving the required reductions – structural stormwater BMP retrofits. A range of presumably more cost-effective measures has been identified but insufficient data is available or yet compiled to support accounting of their nutrient benefits. A Scientific Advisory Board called for under the Jordan nutrient strategy will address existing development accounting and cost and benefit issues across all nutrient strategies. This board will begin work in July 2010 and provide initial products in July 2012. Discussion of the substantial uncertainties around these cost estimates is provided in Step 5: Uncertainties and Risk at the end of the chapter. • As part of assuming BMP retrofits, we assume that sufficient opportunities exist for installation of these BMPs to achieve the needed reductions. However, an assessment done by the City of Durham for the Ellerbe Creek watershed suggests significantly fewer opportunities exist than would be needed. We assume that this combination of the need for and the emerging availability of other, more cost-effective options will drive development of those options over the timeframes of this rule, leading to ***lower costs*** than estimated here. Discussion of the substantial uncertainties around these cost estimates is provided in Step 5: Uncertainties and Risk at the end of the chapter. • We assume compliance by 2021 with the Stage I requirement of returning loads to 2006 baseline levels. We assume that load reductions equating to the strategy's N and P percent goals are achieved by the end of Stage II in 2036. We assume constant rates of implementation through each stage. We assume that implementation will begin in 2011 despite the rule's allowance for local governments to begin implementing as late as January 2014. We base this last assumption on recognition of the legislative provision in SL 2009-486 for early adoption credit, local interest expressed in this option, and the level of preparedness and implementation shown by Durham and others to date. This local initiative is driven in part by existing Neuse stormwater requirements to identify and develop planning information on a certain number of retrofit opportunities each year, and in part by the proactive nature of these local governments, which includes Durham having completed watershed restoration planning for at least two of its Falls watersheds. • Instead of separate calculations for each local government, we carry out all calculations for the entire watershed, divided into 3 development types – county residential, municipal residential, and commercial/industrial/multi-family residential. We assume that the characterization we developed for each type provides a reasonable central tendency for the variations that will occur across projects, jurisdictions and time. • We assume that retrofit BMPs and load reductions will be distributed across the three development types consistent with their proportions in the watershed. Based on Durham's Ellerbe watershed assessment, local governments may need to seek opportunities wherever available across all development types. • We estimate the extent of lands meeting the rule's definition of existing development by combining two components. The great majority of these lands are identified using Multi-Resolution Land Cover satellite imagery taken in 2000 as part of the National Land Cover Database. We then estimate additional acres developed between 2000 and 2013 (the point at which development falls under the New Development rule) using a several-step process that begins with population data from the 2000 Decennial US Census (Census) and that uses county

	population growth projections from the NC Office of State Budget and Management (OSBM). This data is drawn from Pate, 2009. We assume several things through these steps, including the following: • That population growth in this transition period to 2013 is uniform across Census blocks within a county, allowing us to infer growth in Falls watershed's portions. • That growth projections made from 2000 population by OSBM are reasonable estimates amounting to approximately 1.7 % per year. • That all type of developed land acres grow in the same proportions as population over the transition period. • We assume that types of development will occur in the same proportions as those types existed in 2000 as interpreted from the MRLC satellite data. To estimate loading rates from the 3 developed land uses, we rely on literature values for the Albemarle-Pamlico region and an export method developed by NCSU for Tar-Pamlico stormwater rule implementation that is applicable to this area, the Tar-Pamlico export method, Piedmont Version. We assume that values produced by this runoff loading method may be compared to literature loading values, and that the method provides a reasonable approximation of loading changes to surface waters in the watershed and to Falls Reservoir. • We found that the ratio of N to P reductions needed to return to baseline resulted in costs for Stage I being dictated by N control requirements. We found the reverse for Stage II in applying the 40% and 77% reduction goals for N and P respectively. We assume that reduction requirements for the less costly nutrient are met through its co-control at no added cost to that of the more costly one.
Data Sources	Please see the references provided in this section of the New Development chapter.

RP.1 Annual Capital Costs/Savings (Local Governments)

(a) Cost Baseline	There are currently no requirements to reduce nutrient loading from existing developed lands.
(b) Description	Essentially all costs are borne by the local governments. State agency opportunity costs are incorporated in single estimates provided in the New Development chapter. Capital costs include the costs of purchasing land or obtaining easements for stormwater retrofit BMPs and all construction costs for those BMPs. We recognize in the table the conservative nature of our estimates by noting that a lesser value is likely even for Stage I estimates.

(c) Quantify $	2011 < $ 22.1 m 2012 < $ 22.6 m 2013 < $ 23.1 m 2014 < $ 23.6 m 2015 < $ 24.0 m 2016 < $ 24.5 m 2017 < $ 25.0 m 2018 < $ 25.5 m 2019 < $ 25.9 m 2020 < $ 26.4 m NPV Stg I < $ 169 m NPV Stg II < $ 403 m NPV Stg I+II < $ 571 m

(d) Quantification Method	Our approach was to first calculate load reductions needed, determine per BMP costs for the range of BMPs available, calculate load-reducing effectiveness for each BMP, assign each a proportion of total BMP use, distribute total load reduction among them accordingly, and equate the resulting number of each BMP type to reduction costs that are then totaled. More specifically we did the following for each of Stage I and Stage II: 1. Calculate annual mass load reduction needed from 2006 baseline loading (Stage II goals) and separately for development that is added during the post-baseline or transitional period, the period after baseline and before new development programs begin in 2013 (Stage I goals). 2. Unit BMP costs ($/BMP): the sum of capital, BMP land costs, and planning. Unit operation and maintenance costs are also estimated. Capital includes both construction – materials and labor - and land purchase. 3. Unit BMP Effectiveness: Annual mass load removed per BMP (lb/yr/BMP), the product of land use loading rate (lb/ac-yr), BMP drainage area (ac) and BMP removal efficiency (%). 4. Distribute total load reduction need for each rule stage across the BMPs to determine number of each BMP ultimately needed using the results of step 3. Equate number to cost using the results of step 2. Distribute total cost uniformly across the 10 or 15 year period of the respective stage to estimate annual cost. Add in compounding operation and maintenance (O&M) cost based on number of BMPs/yr added for the years of each stage. **Step 1: Calculating Load Reductions Needed** We first estimated acres of development in the watershed through 2012 using the method described in the New Development rule chapter, Capital Cost Quantification. This method relied in part on 2001 satellite-based land cover, and for acres added 2002-2012 estimated these increases as proportional to population growth rate relative to 2001 for each of three broad development types – county residential, municipal residential, and commercial/industrial. Because this rule requires reducing loads to 2006 strategy baseline levels for Stage I, we also

estimated developed acres as of 2006. Table 3.3 illustrates the first steps in this process, showing projected growth rates and 2001 developed acreages for the three development types.

We converted developed acres of each type into lb/yr mass loads using unit-area loading rates described in the New Development chapter. We estimated loads for both 2006 and 2013. The difference represented the Stage I reduction needs. Given that Stage II requirements apply to only the upper watershed, we applied the strategy percent goals to the 2006 loads in the Upper Falls watershed to yield the Stage II reduction goals. We factored credit into the Stage I reduction need estimates for treatment that local governments are requiring under Phase II, Water Supply Watershed and Neuse stormwater requirements for acres developed between 2006 and 2013. Table 3.4 provides unit-area loading rates used. The "untreated" rates were applied to 2006 developed acres, while the "Neuse/WSW/Phase II-treated" rates were applied to the acres added 2006-2012. Table 3.5 provides resulting Stage I and Stage II load reduction needs. Full calculations illustrating the steps of this process are included in Appendix C.

As mentioned in the General Assumptions section above, the relative N and P load reduction needs shown in Table 3.5 below differ between Stages I and II. The ratio of N to P reduction need in Stage I is approximately 7.4:1, while the ratio for Stage II is lower, approximately 4:1 N:P. This is due to the fact that Stage I load reductions are simply amounts in excess of baseline values, while Stage II reductions are based on 40% and 77% goals for N and P respectively. As a result, we find that Stage I costs are controlled by N reduction needs while Stage II are controlled by P reduction needs.

Table 3.3: Growth Projections and 2001 Developed Acres, Falls Watershed

	Population, 2001	**%Growth 2006**	**% Growth 2013**	
Upper 5	13,950	**8.69%**	**9.42%**	
Lower	9,197	**17.35%**	**17.99%**	
Total	23,147	**10.84%**	**11.67%**	
	Land Cover 2001 (Ac)			
	County Residential	**Muni Residential**	**Commercial /Industrial**	**All Developed**
Upper 5	26,185	6,883	3,754	36,822
Lower	13,312	2,968	704	16,984
Total	**39,497**	**9,851**	**4,458**	**53,806**

Table 3.4: Unit-Area Loading Rates Used to Estimate Annual Mass Loads in the Falls Watershed

	Untreated Unit-Area Loading Rates		
Land Cover	**County Residential**	**Municipal Residential**	**Commercial /Industrial**
N (lb/ac/yr)	2.80	7.50	12.50
P (lb/ac/yr)	0.46	0.90	1.10
	Neuse/WSW/Phase II-Treated Unit-Area Loading Rates		

Land Cover	County Residential	Municipal Residential	Commercial /Industrial
N (lb/ac/yr)	2.80	5.03	8.38
P (lb/ac/yr)	0.46	0.52	0.72

Table 3.5.a: Existing Development Stage 1 Load Reduction Needs

Stage 1 Nitrogen Reduction Goals as N Load Added '06=>'12 (lb N/yr)

	County Residental	Muni Res.	Commer/Industial	All Developed
Upper 5	7,506	3,544	3,220	14,271
Lower	7,867	3,151	1,245	12,263
Total	**15,373**	**6,695**	**4,465**	**26,534**

Stage 1 Phosphorus Reduction Goals as P Load Added '06=>'12 (lb P/yr)

	County Residental	Muni Res.	Commer/Industial	All Developed
Upper 5	1,233	366	277	1,876
Lower	1,292	326	107	1,725
Total	**2,526**	**692**	**384**	**3,601**

Table 3.5.b: Existing Development Stage 2 Load Reduction Needs

Stage II 40% Nitrogen Load Reduction from 2006 Baseline (lb N/yr)

	County Residental	Muni Res.	Commer/Industial	All Developed
Upper 5	31,877	21,853	19,862	**73,592**

Stage II 77% Phosphorus Load Reduction from 2006 Baseline (lb P/yr)

	County Residental	Muni Res.	Commer/Industial	All Developed
Upper 5	10,081	5,010	3,360	**18,451**

(d) Quantification Method (continued)	**Step 2: Per-BMP Costs** In this step we calculate unit BMP cost for the range of available BMPs as we did and described for New Development. Please refer to the New Development chapter for that description. As with the new development calculations, we inflated dollar values obtained in past years to 2012 and later as appropriate. We made the following changes for the differing characteristics of existing development: • To address the concern that retrofitting practices into an already developed landscape results in significantly greater installation costs for a variety of reasons, we used installation cost multipliers for retrofit BMPs identified in Schueler et al, 2007. This study reviewed existing cost studies nationwide and appears to be the most comprehensive and current source available. Methods, assumptions, and limitations for the retrofit multipliers are documented in Appendix E of that study. These multipliers ranged from 1 for sand filters to 7 for stormwater wetlands, with most being around 2. • We increased planning costs from the 25-30% used for new development to 35% based on input from North Carolina State University stormwater

	expert Dr. William Hunt. Additional evaluation and planning are required to work stormwater practices into an existing developed landscape compared to green field development. • We zeroed out regulatory transaction costs as not applicable to existing development.

(d) Quantification Method (continued)	**Steps 3 and 4: Unit BMP Effectiveness, Number of BMPs Needed, and Costs** Again, we used the same process as described in the New Development chapter. For existing development we made these changes: • We modified the BMP proportions greatly to reflect likely options in existing developed settings, based in part on input specific to existing developed settings from City of Durham Stormwater Services staff as well as on cost-effectiveness. We shifted choices to the following: o Stormwater Wetlands 30% o Bioretention 27% o Infiltration Devices 25% o Buffer restoration 13% o Grassed Swales 5% • We used untreated BMP inflow loading rates based on the assumption that the great majority of BMPs would be installed on untreated lands. We based this assumption on our estimate that approximately 90% of watershed lands were developed prior to requirements for treatment, and a significant fraction of those lands developed pursuant to requirements were zoned to keep densities below thresholds that would require treatment. In addition, we reasoned that local governments implementing the requirements of this rule would avoid installing BMPs in series with existing BMPs for as long as possible driven by both a reduced credit value and a likely greater practical difficulty siting such BMPs. While these inflow loading rates reflect untreated conditions, they were set to reflect the absolute density ceilings required by WSW regulations, meaning that they are lower than what would be expected outside water supply watersheds. As expected, BMPs showed better cost-effectiveness when treating untreated input loading rates than they would as second BMPs. We used the following input loading rates in lb/ac/yr: N P o County residential 2.8 .46 o Municipal residential 7.5 .90 o Commercial/Industrial 12.5 1.1 We distributed load reductions for each stage and associated initial BMP costs – capital and planning - uniformly across all years of the stage. We compounded O&M costs by a constant annual increment correlated with the number of BMPs

	across all years of the stage.
(e) Assumptions	• Please see the General Assumptions at the beginning of this section. • As covered in more detail in the General Assumptions section above, we assumed costs would be incurred uniformly across all years of a stage. • We use N and P removal efficiencies set out in the Division's NC Stormwater BMP Manual. • Capital costs include land, materials, and installation labor. • We assume BMP lifespans of 30 years, resulting in no replacement costs within the analysis period. We believe there is relatively little real-world data on the nature of long-term BMP maintenance, repair, or replacement that might guide alternative assumptions. However, observations of professionals in the field support the belief that longer-term costs are proving to involve periodic minor repairs rather than complete loss provided that regular maintenance is performed as costed here.
(f) Data Sources	• Schueler et al, 2007. Urban Subwatershed Restoration Manual Series, Manual 3: Urban Stormwater Retrofit Practices. Appendix E, Derivation of Unit Costs for Stormwater Retrofits and New Stormwater Treatment Construction. August 2007. Center for Watershed Protection, Ellicott City, Maryland.

RP.2 Annual Operating Costs/Savings (Local Governments)

(a) Cost Baseline	Since there are currently no requirements to reduce nutrient loading from existing developed lands, local governments do not incur O&M costs.
(b) Description	BMPs require maintenance to continue to work effectively. Examples of maintenance include maintaining plants, removing debris, and mowing.

(c) Quantify $	Unit BMP Annual O&M Costs: $200 - $340/BMP Stage I Annual O&M Increment: $189,000 (unadjusted for inflation) Stage II Annual O&M Increment: $532,000 (unadjusted for inflation) 2011 < $ 190 k 2012 < $ 390 k 2013 < $ 600 k 2014 < $ 820 k 2015 < $ 1.0 m 2016 < $ 1.3 m 2017 < $ 1.5 m 2018 < $ 1.8 m 2019 < $ 2.0 m 2020 < $ 2.3 m NPV Stg I < $ 7.5 m NPV Stg II < $35.8 m NPV Stg I+II < $43.3 m
(d) Quantification Method	We used the same calculation method and values as those described in the New Development chapter. One difference for existing development was that we calculated Stage I and Stage II O&M separately except that we carried over the Stage I final year annual O&M cost, $2.3 million, as the base rate on which annual Stage II O&M increments begin to compound. We compounded O&M costs by a constant annual increment correlated with the number of BMPs across all years of the stage. Final annual Stage II O&M in 2036 was $15.7 million.
(e) Assumptions	Please see the New Development chapter. Values reflect labor costs for inspection, maintenance and repairs.
(f) Data Sources	Please see the New Development chapter.

RP.3 Annual Planning Costs/Savings (Local Governments)

(a) Cost Baseline	Since there are currently no requirements to reduce nutrient loading from existing developed lands, local governments do not incur planning costs.
(b) Description	Local governments would incur planning costs related to seeking and pursuing retrofit and other load reduction opportunities, then designing practices. Planning is estimated as 35% of the construction cost.

(c) Quantify $	Unit BMP Planning Costs: $175 - $19,500/BMP Totals: 2011 < $ 6.4 m 2012 < $ 6.6 m 2013 < $ 6.7 m 2014 < $ 6.8 m 2015 < $ 7.0 m 2016 < $ 7.1 m 2017 < $ 7.3 m 2018 < $ 7.4 m 2019 < $ 7.5 m 2020 < $ 7.6 m NPV Stg I < $ 48.9 m NPV Stg II < $112 m NPV Stg I+II < $161 m
(d) Quantification Method	We used the same calculation method and values as those described in the New Development chapter. Features specific to existing development include the following: • We used a planning cost of 35% of installation cost based on recommendations contained in Schueler et al, 2007 and expert input from Dr. William Hunt, North Carolina State University. • Since we used construction cost multipliers for retrofits, planning costs increased commensurately for existing development relative to new development.
(e) Assumptions	Please see the New Development chapter. We assumed that planning costs estimated here captured the cost of new staff that would be needed to implement local existing development programs.
(f) Data Sources	• Schueler et al, 2007. Urban Subwatershed Restoration Manual Series, Manual 3: Urban Stormwater Retrofit Practices. Appendix E, Derivation of Unit Costs for Stormwater Retrofits and New Stormwater Treatment Construction. August 2007. Center for Watershed Protection, Ellicott City, Maryland. • Please also see the New Development chapter.

RP.4 Regulatory Transaction Costs/Savings (Local Governments)

(a) Cost Baseline	Since there are currently no requirements to reduce nutrient loading from existing developed lands, local governments do not incur regulatory transaction costs.
(b) Description	Potential for occasionally needing state permits.
(c) Quantify $	$0

(d) Quantification Method	n/a
(e) Assumptions	We assumed that these costs would be insignificant for existing development.
(f) Data Sources	n/a

4-B. Implementing Agencies:

IA.0 Party Description (DWQ)

Name of Party	DWQ
Description	Division staff in the NPS Planning Unit would coordinate implementation. Staff from the Stormwater Permitting Unit, Modeling Unit, and Raleigh Regional Office would provide assistance as needed.
General Baseline	The Division currently administers a number of stormwater programs from central and regional offices. However, none of these programs require reductions from existing developed lands. Neuse and Tar-Pamlico stormwater programs require local governments to identify and report on retrofit opportunities, and the Division reviews those reports. The Jordan nutrient strategy includes existing development requirements similar to this rule's, which became effective August 2009. Products from the Jordan process will be utilized in implementing this rule.
Assumptions	No new staff resources will be allocated to implement this rule. Responsibilities will be incorporated into existing work plans. To some extent this represents an opportunity cost. Because existing staff will implement all rules of the strategy, we estimate these opportunity costs in aggregate once in the New Development rule, and do not repeat them here.
Data Sources	N/A

IA.1 Regulatory Development Costs/Savings (DWQ)

(a) Cost Baseline	Several Division staff worked to develop loading reduction targets for the strategy, collect data and other information, draft rules and fiscal estimates, and coordinate and participate in stakeholder meetings.
(b) Description	NPS Planning Unit staff would continue to coordinate implementation, utilizing other staff as described above, and work with local governments. The rule requires the Division to develop a model local program within 2 ½ years. Staff would participate in and utilize products of the Scientific Advisory Board required under the Jordan nutrient strategy as part of the model program. Staff will hold meetings to advise local governments collectively and individually on program development.
(c) Quantify $	Costs given in the New Development chapter capture DWQ staff opportunity costs associated with implementing this rule. Supporting information is included in Appendix B.
(d) Quantification Method	The Division would rely on existing resources to implement the rule.

(e) Assumptions	N/A
(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings (DWQ)

(a) Cost Baseline	Neuse, Tar-Pamlico, and Jordan stormwater rules require local governments to report annually on several requirements addressing existing development: stormwater system mapping, illicit discharge detection and elimination programs, and education programs. Neuse and Tar also require identifying a minimum number of candidate retrofit sites. Jordan Stage II requires development, approval and implementation of existing development load reduction programs beginning as early as 2014, results of which will be added to annual reporting.
(b) Description	Division staff will oversee compliance with requirements of this rule, including annual reporting on progress relative to implementation plans. Tasks will include tracking of load reduction needs and tracking and verification reductions reported.
(c) Quantify $	Costs given in the New Development chapter capture DWQ staff opportunity costs associated with implementing this rule. Supporting information is included in Appendix B.
(d) Quantification Method	The Division would rely on existing resources to implement the rule.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.3 Permitting Costs and Savings (DWQ)

(a) Cost Baseline	There are currently no permitting requirements associated with existing development except those developed areas that are re-developed. Those activities are treated as new development. Staff of the Stormwater Permitting Unit handle NPDES Phase II permitting in counties in the watershed.
(b) Description	Other than ongoing permitting of re-development in counties with existing staff as described above, there would not be permitting associated with existing development.
(c) Quantify $	Costs given in the New Development chapter capture DWQ staff opportunity costs associated with implementing this rule. Supporting information is included in Appendix B.
(d) Quantification Method	The Division would rely on existing resources to implement the rule.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.4 Inspection and Enforcement Costs/Savings (DWQ)

(a) Cost Baseline	The Monitoring/Recordkeeping section above addresses this area.
(b) Description	The Monitoring/Recordkeeping section above addresses this area.
(c) Quantify $	Costs given in the New Development chapter capture DWQ staff opportunity costs associated with implementing this rule. Supporting information is included in Appendix B.
(d) Quantification Method	The Division would rely on existing resources to implement the rule.
(e) Assumptions	N/A
(f) Data Sources	N/A

Step 5: Uncertainty and Alternatives

The long-term nature of this rule and the rapidly evolving field of watershed restoration combine to make projection of costs more than a few years into the future increasingly speculative. We used structural stormwater BMP retrofits as the basis for our estimates because at this point values for other measures would be difficult to develop and apply broadly without undue complexity. We expect more cost-effective measures than structural stormwater BMP retrofits to emerge even during the course of Stage I. Thus we expect costs at any point to be less than the estimates given here.

To gauge the uncertainty associated with our conservative, high-end estimates we evaluated other lines of information. We found values both significantly below and significantly above ours. Our primary additional calculation utilized cost-effectiveness values developed by Research Triangle Institute for the General Assembly in 2007 as part of discussions around nutrient offset options in the development of SL 2007-438. Application of the RTI values to Falls load reduction needs resulted in total costs that were roughly half of our inflated, undiscounted estimates. Use of RTI's median cost-effectiveness values for the practices that we projected yielded a total combined cost for Stages I and II of $1.0 billion in raw dollars. As a second check on our high-end estimate, the City of Durham developed a watershed assessment for the restoration of water quality in Ellerbe Creek, and subsequently extrapolated those findings to the rest of their jurisdiction. They estimated a cost of approximately $645 million to achieve roughly one-third of the Falls nitrogen goal and one-quarter of the phosphorus goal through conventional BMP retrofits, and determined that further reductions were not feasible. A rough extrapolation of that cost to the entire Falls watershed produces a cost of approximately $1.5 billion to achieve the same fractions of the goals. This suggests a much greater ultimate cost than we have estimated as high-end, or simply unachievable reductions. We expect, however, that more cost-effective solutions to conventional BMP retrofits will continue to emerge, making costs of this nature unnecessary.

One reason to expect that more cost-effective solutions will emerge is that both this rule and federal regulatory changes will drive innovation to address loading contributions from existing developed lands. A growing movement at the federal level has identified the need to address the water quality impacts of existing developed lands as a necessary element of responsible water resource management, and the need for states to strengthen nutrient standards and controls. Recent federal reports recognize the need for watershed-based permitting, assignment of loading caps to communities, a multi-faceted approach to load reduction, and addressing of loads from existing development to address the Chesapeake Bay impairment (OIG, 2007) and stormwater-related water quality problems nationwide (NRC, 2008). Based in part on the latter report, in late 2009 the US EPA announced its intent to undertake major new rulemaking to reduce stormwater impacts of both new development and existing

development. EPA proposes in part to require communities nationwide to address stormwater discharges in areas of existing development through retrofitting the sewer system or drainage area with improved stormwater control measures (EPA, 2009). In addition, EPA has been increasingly pushing the states in recent years to adopt more stringent nutrient standards. North Carolina is currently seeking to persuade EPA that the progressive nature of our nutrient strategies based in existing nutrient-related standards is an effective program. Altogether, we expect that actions to address nutrient loading impacts of existing developed lands will only increase nationwide in the foreseeable future, and that technologies and management strategies for doing so will greatly advance concurrently.

Another reason to expect that more cost-effective solutions will emerge is the promising range of currently emerging practices. A number of drivers, including the growing need for water conservation, the costs of conventional retrofit approaches under this rule, and the growing field of alternative options are expected to result in ultimate compliance costs significantly lower than these projections suggest. A Scientific Advisory Board required under the Jordan nutrient strategy will be addressing these issues and developing credit and accounting options during the next two years and beyond. In addition to structural retrofits, which are also evolving to be more effective, practices that local governments will likely be able to take increasing advantage of in the future may include:

Programmatic:

- Requiring treatment on redevelopment
- Pet waste regulation
- Fertilizer application regulation
- Improved street sweeping
- Retrofitting existing stormwater quantity ponds
- Off-line regional treatment facilities
- Small-scale property owner practices, e.g. redirecting impervious surfaces

Wastewater:

- Removing onsite sand filter discharges
- Correcting malfunctioning septic systems
- Improvement of wastewater collection systems
- Eliminating illicit discharges

Ecosystem Restoration:

- Stream, wetland and riparian buffer restoration
- Purchase and reforestation of agricultural land

Innovations are also appearing in engineered stormwater controls that were not considered in this chapter's cost estimates:

- Rainwater harvesting
- Redirecting impervious surface runoff
- Floating wetland retrofits
- Green roofs
- Conversion of raised parking islands to structural BMPs
- Stormwater inlet conversion to bioretention

Sources:

EPA, 2009. Proposed National Rulemaking to Strengthen the Stormwater Program. US Environmental Protection Agency, http://cfpub.epa.gov/npdes/stormwater/rulemaking.cfm.

NRC, 2008. Urban Stormwater Management in the United States. National Research Council of the National Academies. National Academies Press, Washington, DC. October 2008.

OIG, 2007. Development Growth Outpacing Progress in Watershed Efforts to Restore the Chesapeake Bay. Office of Inspector General, US Environmental Protection Agency. Report No. 2007-P-00031, September 2007.

RTI International, 2007. *A Study of the Costs Associated with Providing Nutrient Controls that are Adequate to Offset Point Source and Nonpoint Source Discharges of Nitrogen and Other Nutrients*. Final Report, June 2007. RTI International, Research Triangle Park, NC and Center for Watershed Protection, Ellicott City, MD.

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Chapter 4: Wastewater Discharge Requirements

Step 1: Basic Information

1.1 Rule Reference No.	.0279
1.2 Analyst	Michael E. Templeton, Environmental Engineer
1.3 Office	Division of Water Quality Point Source Branch 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Telephone	(919) 807-6402
1.5 Comments on Agency Contact	None
1.6 Title of the Proposed Rule	Falls Water Supply Nutrient Strategy: Wastewater Discharge Requirements
1.7 Citation	15A NCAC 2B .0279
1.8 Brief Description of the Proposed Rule	The proposed rule would require point source wastewater dischargers to limit their nutrient discharges to surface waters in the Falls Reservoir watershed. Dischargers in the Upper Falls watershed must reduce their collective contributions in order to satisfy specific nutrient reduction goals established for that portion of the watershed. Three facilities in the Upper Falls watershed would have to meet interim Stage 1 limits by 2016 and final Stage 2 limits by 2036. Stage 1 mass limits are equivalent to approximately 3.05 mg/L TN and 0.33 mg/L TP at 110% of current flows. Stage 2 limits are equivalent to approximately 1.1 mg/L TN and 0.06 mg/L TP at full permitted flows and would become the most stringent nutrient limits in North Carolina. By comparison, mass limits for Neuse River basin dischargers are equivalent to 3.7 – 5.5 mg/L TN at permitted flows; and those for the Jordan Lake dischargers are equivalent to 3.0 – 5.3 mg/L TN and 0.23 – 0.66 mg/L TP. Two facilities in the Lower Falls watershed must meet technology-based concentration limits of 5.5 mg/L TN and 0.5 mg/L TP (annual average) by 2016. The facilities are downstream of the greatest nutrient impacts and so are not subject to Stage 2 limits. The regulatory framework and many of the rule's general nutrient control provisions are similar to the nutrient management strategies already established in the Neuse River basin (T15A NCAC 02B .0234) and the Jordan Lake watershed (02B .0270).
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary.

Step 3: Define the Problem and the Regulation

3.1 Why Is The Regulatory Proposal Needed?
The Executive Summary describes the need for the Falls Reservoir nutrient management strategy and its component rules.

3.2 How Will The Proposed Rule Change Achieve Its Purpose?
The proposed rule establishes nutrient control requirements for point source discharges in the Falls Reservoir watershed. These include nitrogen and phosphorus discharge limits for significant dischargers in the Upper and Lower portions of the watershed, consistent with the nutrient-reduction objectives of the "Goals rule" (02B .0275). The Division of Water Quality (DWQ) will implement these limits through the treatment facilities' NPDES wastewater discharge permits.

The rule applies to all existing and future wastewater treatment facilities in the Falls watershed that receive nutrient-bearing wastewaters and are subject to requirements for individual NPDES discharge permits. Existing facilities subject to the new rule are listed in Table 4.1.

Table 4.1
Existing Wastewater Treatment Facilities – Falls Reservoir Watershed

NPDES Permit	Owner	Facility Name	Facility Type	Flow 1 (MGD)
Upper Falls Watershed				
NC0023841	City of Durham	North Durham WRF	Major Municipal	20.0
NC0026824	South Granville W&SA	SGWASA WWTP	Major Municipal	5.5
NC0026433	Town of Hillsborough	Hillsborough WWTP	Major Municipal	3.0
NC0059099	Aqua NC, Inc.	Lake Ridge Aero Park WWTP	100% Domestic	0.0160
NC0056731	The Chesson Group	Grande Oak Subdivision WWTP	100% Domestic	0.0068
NC0037869	Arbor Hills MHP	Arbor Hills MHP WWTP	100% Domestic	0.0060
Lower Falls Watershed				
NC0049662	Aqua NC, Inc.	Hawthorne Subdivision WWTP	100% Domestic	0.25
NC0063614	Aqua NC, Inc.	Wildwood Green WWTP	100% Domestic	0.10

Footnote
[1] Maximum permitted flows as of 2006 (baseline year). The Stage 2 point source nutrient allocations for the Upper Falls dischargers are divided in proportion to these flows.

Dischargers in the watershed are already subject to nutrient control requirements under the Neuse River Basin Nutrient Management Strategy and its wastewater rule, T15A NCAC 02B .0234, which were adopted to restore water quality in the Neuse River estuary. The requirements of the proposed rule are similar in many respects to those already in place but would establish more stringent nutrient limits necessary to protect water quality in the reservoir. For the purposes of this chapter, the existing rule – and the nutrient controls implemented as a result – serve as the baseline condition for the proposed rule.

Upper Falls Strategy

The nutrient controls proposed for Upper Falls dischargers are similar to those already established in both the Neuse River basin (02B .0234) and the Jordan Lake watershed (02B .0270). It establishes allowable nutrient loads (allocations) for dischargers in the watershed (Goals rule, 02B .0275), distributes those allocations among the existing dischargers, and requires "large" dischargers to meet the resulting discharge limits within specified timeframes.

The rule sets discharge limits only for large facilities, that is, those with permitted flows of 0.1 million gallons per day (MGD) or greater. Smaller facilities are also assigned nutrient allocations but do not receive limits at this time because of their relatively minor impacts on the reservoir. (Small dischargers

A BRIEF GLOSSARY OF TERMS

"Permitted flow" is defined in the rule as the maximum flow limit in a facility's permit as of 12/31/2006, the end of the baseline period for the Falls nutrient modeling.

"MGD" means million gallons per day, a measure of wastewater flow and of wastewater treatment plant capacity.

"Large" facilities are defined as those permitted for 0.1 MGD or greater discharge by the end of 2006.

"TN" means Total Nitrogen, a measure of nitrogen in its various forms in the wastewater.

"TP" means Total Phosphorus, a measure of phosphorus in its various forms in the wastewater.

"BNR" means, depending on the context, biological nutrient removal or biological nitrogen removal.

may still receive limits in certain situations, such as at expansion, and the Division has existing legal authority to establish new or more stringent limits for any facility when it finds those are necessary to protect water quality.)

The rule uses a two-stage approach to achieve nutrient targets in the Upper watershed. Large dischargers must meet interim Stage 1 limits in 2016 (5 years after rule adoption) and final Stage 2 limits in 2036 (25 years).

The Stage 1 limits require the dischargers to reduce their aggregate nitrogen and phosphorus loads to the reservoir by 20% and 40%, respectively. The limits are expressed as annual mass loads discharged to the receiving stream and are equivalent to 3.05 mg/L total nitrogen (TN) and 0.33 mg/L total phosphorus (TP) at 110% of current (2008-09) flows.

The Stage 2 limits represent the discharge levels that will satisfy the 40% nitrogen and 77% phosphorus reductions targets for point sources in the Upper Reservoir. The limits are expressed as annual mass discharge loads and are equivalent to approximately 1.1 mg/L TN and 0.06 mg/L TP at the facilities' full permitted flows.

The 'Concentration and Mass Discharge Limits' box (below) explains the differences between the two types of limits and some of the implications of mass limits for the dischargers.

Lower Falls Strategy

Dischargers in the Lower watershed must also meet Stage 1 limits by 2016. Unlike limits in the Upper watershed, these are expressed as concentration limits and are the final limits for the affected dischargers. The proposed limits are 5.5 mg/L TN and 0.5 mg/L TP as annual averages, 8.0 mg/L TN and 1.0 mg/L TP as monthly averages.

The nutrient discharge limits and compliance dates from the proposed rule are summarized in Tables 4.2 and 4.3, respectively.

Other Provisions

In addition to the discharge limits, the Falls Wastewater Discharge Requirements include other provisions similar to those already adopted for the Neuse River basin and the Jordan Lake watershed.

New and expanding dischargers. As in the previous strategies, the Falls wastewater rule assigns all available allocation to the existing dischargers. It does not set aside allocations for new or expanding discharges. In the Upper Falls watershed, new or expanding discharges can be permitted if (1) no other feasible option to the discharge exists, (2) the proponent either obtains allocations from other existing point sources or offsets its added nutrient load through a mitigation bank (i.e., no net increase), <u>and</u> (3) the

new treatment system is designed to meet annual mass limits no greater that the equivalent of 3.0 mg/L TN and 0.1 mg/L TP at the facility's permitted flow. (These concentrations were selected before the Stage 2 limits were calculated and are lenient by comparison. They have little impact as written and may be reconsidered before final adoption.)

In the Lower Falls watershed, the rule prohibits new or expanding discharges. The strategy in this watershed is to apply technology-based limits that will not allow nutrient loads to rise above the 2006 baseline levels. The proposed concentration limits will initially reduce nutrient discharge loads below the baseline at the facilities' current flows. However, if their flows were to increase significantly or if new facilities were allowed to discharge at the same concentrations, nutrient loads would eventually exceed the 2006 levels. Thus, the approach to preventing that is to set technology-based limits and prohibit any increase in the total permitted discharge flow in the Lower watershed.

Table 4.2
Proposed Nutrient Discharge Allocations and Limits[1]

Discharger/ Limit Subcategories	# of Dischargers	Total Nitrogen		Total Phosphorus	
Upper Falls Watershed		Mass Allocation/ Limit (lb/yr)	Equiv. Conc. (mg/L)	Mass Allocation/ Limit (lb/yr)	Equiv. Conc. (mg/L)
Permitted Flows > 0.1 MGD	3				
Stage 1 (Interim)		**128,686**	3.0[2]	**14,008**	0.33
Stage 2 (Final)		**95,858**	1.1[3]	**5,228**	0.06
Permitted Flows < 0.1 MGD	3				
Stage 1 (Interim)		**527**[4]	12	**88**[4]	2
Stage 2 (Final)		**1,052**[4]	12	**175**[4]	2
Lower Falls Watershed		Concentration Limits (mg/L)		Concentration Limits (mg/L)	
		Annual Avg.	Monthly Avg.	Annual Avg.	Monthly Avg.
Permitted Flows > 0.1 MGD	2				
Stage 1 (Final)		**5.5**	**8.0**	**0.5**	**1.0**
Permitted Flows < 0.1 MGD	0	N/A	N/A	N/A	N/A

Footnotes
[1] Values stated in the proposed rule are shown in Bold.
[2] Annual average concentrations at 110% of current flows.
[3] Annual average concentrations at full 2006 permitted flows.
[4] Allocations only, no limits at this time.

Table 4.3
Wastewater Requirements Timeline

Activity	Effective Date[1]	Implementation Schedule
Existing dischargers permitted for 0.1 MGD or greater must meet Stage 1 limits for TN and TP.	1/1/2016	5 years
Existing dischargers located in the Upper Falls watershed and permitted for 0.1 MGD or greater must meet Stage 2 limits for TN and TP.	1/1/2036	25 years
The Director shall establish more stringent limits for nitrogen or phosphorus upon finding that such limits are necessary to protect water quality standards in localized areas.		

Footnote
[1] Assuming the rule becomes effective 1/1/2011.

Group compliance. The proposed rule includes a group compliance option similar to those available in the Neuse and Jordan watersheds. In this option, interested dischargers in each watershed can elect to work collectively to meet their combined nutrient limits rather than be subject to their individual limits. This approach allows the dischargers a degree of flexibility in meeting the point source nutrient targets. It is most effective if one or more facility surpasses its treatment requirements and generates 'surplus' allocation.

Trading and regionalization. The proposed rule allows dischargers to transfer nutrient allocation ("trade") among themselves, provided that the transfers do not cross the Upper/ Lower watershed boundaries and do not cause localized water quality impacts in the receiving streams. The rule specifically provides that, when one facility connects to another in the same watershed and eliminates the first's discharge to surface waters, that facility's nutrient allocations are transferred in full to the remaining facility.

Overlap with Existing Neuse River Requirements

The Neuse River Wastewater Requirements apply to dischargers throughout the basin, including the Falls Reservoir watershed. Many of the features of the Falls wastewater strategy are similar to those in the Neuse River strategy. This provides a consistent approach where the strategies are similar, but there are some differences between the strategies. For example, the strategies assign differing nitrogen allocations, each calculated to protect different waterbodies, so the facilities will be subject to two different discharge allocations. The Upper Falls allocations will be more stringent than the Neuse allocations and will become the governing limits. The additional discharge allocation remaining under the Neuse rule effectively becomes 'reserve' allocation and can no longer count toward the facility's nitrogen limit.

Concentration v. Mass Discharge Limits

Discharge limits for many parameters are expressed as the average concentration not to be exceeded in any given month. In effect, concentration limits define the level of treatment that must be met. When this is intentionally the case, the limit is referred to as a technology-based limit.

Limits that are specifically calculated to protect water quality in a waterbody are often expressed as mass limits so as to limit the *amount* of pollutant discharged. For this reason, the nutrient limits proposed for the Upper Falls dischargers are annual *mass loads*.

The mass load of a pollutant is calculated as:

Mass (pounds) = Flow (MGD) x Concentration (mg/L) x Units Conversion Factors

Mass limits are commonly expressed as the equivalent concentration of a pollutant at some particular flow rate, such as the facility's permitted flow. This "equivalent" concentration is a useful measure of the level of treatment required to meet the facility's mass limit at that flow.

The nature of a mass load or limit is that, as a facility's flow increases, its nutrient concentration must be reduced proportionally to maintain the same mass; likewise, if flow decreases, the concentration can increase to the same degree. The result is that a facility discharging less than its permitted flow can discharge a pollutant at greater than its final equivalent concentration and still meet its mass limit. It is as the facility nears its full permitted flow – due to population growth, new industry, and other factors – that the facility must reach the final equivalent concentration for that mass limit.

Step 4: Identify Impact

Table 4.4 below provides a summary of projected costs for all affected parties. The table presents costs for each of the first ten years. It then presents net present value costs for the first 10 years (listed as Stage 1), the next 15 years (Stage 2), and the total (25 years).

Note that, for the purposes of this table, Stages 1 and 2 are defined differently than in the wastewater rule. Most of the nonpoint source rules define Stage 1 as 2011-2020 (first 10 years of implementation) and Stage 2 as 2021-2035 (the next 15 years). In order to accelerate water quality improvements, the proposed wastewater rule defines Stage as 2011-2015 (first 5 years of implementation) and Stage 2 as 2016-2035 (the next 20 years). Table 4.4 uses the same time periods as the summary tables in other chapters in order to present costs for consistent time frames.

The result is a Stage 1 NPV of $249.2 million, Stage 2 NPV of $229.4 million, and total NPV of $478.6 million. Had the table presented Stage 1 and 2 costs using the point source definitions, the results would be a Stage 1 NPV of $33.0 million, Stage 2 NPV of $445.6 million, and total NPV of $478.6 million.

All costs presented in Table 4.4 are adjusted for inflation using Consumer Cost Index projections provided by the OSBM.

4-A. Regulated Parties

RP.0 Wastewater Dischargers

Wastewater Dischargers affected by this rule are those existing and future wastewater treatment facilities (point sources) that receive nutrient-bearing wastewater, discharge to surface waters within the Falls Reservoir watershed, and are subject to requirements for individually issued NPDES permits.

General Baseline
The Wastewater Dischargers include eight existing wastewater treatment facilities (Table 4.1). They include three municipal plants (5.5-20 MGD capacity) and five privately owned, 100%-domestic plants (0.006-0.25 MGD capacity). The facilities are already subject to nutrient control requirements under the Neuse River Basin Nutrient Management Strategy – Wastewater Discharge Requirements rule, T15A NCAC 02B .0234.

Six of the eight facilities are located in the Upper Falls watershed. They include three large dischargers – the Durham-North, SGWASA, and Hillsborough WWTPs – which are permitted for a total of 28.5 MGD and accounted for 99.5% of the point source nutrient loadings in the watershed in the 2006 baseline year. The three smaller facilities are permitted for a total of less than 0.03 MGD and accounted for only 0.4% of the point source nutrient loads in 2006.

Two of the eight facilities are located in the Lower watershed. Both are owned and operated by Aqua NC and are permitted to discharge up to 0.1 and 0.25 MGD, respectively. There are no smaller treatment facilities in the Lower Falls watershed.

General Assumptions
The Division assumes that certain types of dischargers are unlikely to contribute significant nutrient loads to surface waters and do not normally warrant regulation under this rule, including commercial operations (e.g., non-contact cooling waters, boiler or cooling tower blowdown), water treatment plants, and groundwater remediation sites.

The Division is not aware of specific plans for new discharges in the watershed and, for the purposes of this fiscal note, assumes there are none. The narrative describes some of the potential costs a new discharger could expect, specifically those related to acquiring nutrient allocations.

Also see assumptions in other subsections of this chapter and refer to the ‘Step 5: Uncertainties and Alternatives’ section of this chapter for additional discussion of other factors affecting implementation costs.

Table 4.4
Summary of Estimated Costs For Total Nitrogen and Total Phosphorus Reductions ($Million) - Wastewater Discharge Requirements[1,2]

	Private				Local Government				State Government	Federal Government	Total
Year	**Planning**	**Capital**	**O&M**	**Total**	**Planning**	**Capital**	**O&M**	**Total**			
2011	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0	$ 0
2012	$ 0.5	$ 0	$ 0	$ 0.5	$ 4.3	$ 0	$ 0	$ 4.3	$ 0	$ 0	$ 4.8
2013	$ 0.5	$ 0	$ 0	$ 0.5	$ 4.4	$ 0	$ 0	$ 4.4	$ 0	$ 0	$ 4.9
2014	$ 0	$ 1.7	$ 0	$ 1.7	$ 0	$ 15.0	$ 0	$ 15.0	$ 0	$ 0	$ 16.7
2015	$ 0	$ 1.7	$ 0	$ 1.7	$ 0	$ 15.3	$ 0	$ 15.3	$ 0	$ 0	$ 17.0
2016	$ 0	$ 0	$ 0.1	$ 0.1	$ 0	$ 0	$ 2.1	$ 2.1	$ 0	$ 0	$ 2.2
2017	$ 0	$ 0	$ 0.1	$ 0.1	$ 0	$ 0	$ 2.2	$ 2.2	$ 0	$ 0	$ 2.3
2018	$ 0	$ 0	$ 0.1	$ 0.1	$ 0	$ 0	$ 2.2	$ 2.2	$ 0	$ 0	$ 2.3
2019	$ 0	$ 0	$ 0.1	$ 0.1	$ <92.4	$ 0	$ 2.3	$ <94.7	$ 0	$ 0	$ <94.8
2020	$ 0	$ 0	$ 0.1	$ 0.1	$ 0	$ <313.1	$ 2.3	$ <315.4	$ 0	$ 0	$ <315.5

Projections of costs for advance treatment technologies and for points 10 years and further into the future involve a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.

Stage 1 NPV[3]	$ 0.8	$ 2.5	$ 0.3	$ 3.6	$ <57.6	$ <181.5	$ 6.5	$ <245.6	$ 0	$ 0	$ <249.2
Stage 2 NPV[4]	$ 0	$ 0	$ 0.5	$ 0.5	$ <33.8	$ <107.3	$ 87.8	$ <228.9	$ 0	$ 0	$ <229.4
Total NPV (Stages 1,2)	$ 0.8	$ 2.5	$ 0.8	$ 4.1	$ <91.4	$ <288.8	$ 94.3	$ <474.5	$ 0	$ 0	$ <478.6

Footnotes:

[1] Beyond initial BNR improvements, costs are based on an 'advanced treatment only' approach without consideration of reuse and other alternatives, which could significantly affect the costs and timing of the added improvements. These are meant to approximate high-end costs for implementing the wastewater requirements rule, as conditioned in this chapter.

[2] All costs are adjusted for inflation based on CPI projections (approximately 1.8% per annum). Inflation-adjusted costs are then discounted to 2010 values at a rate of 7% per annum to arrive at net present value (NPV) costs.

[3] Stage 1 costs include projected from 2011 through 2020 (see text, Step 4).

[4] Stage 2 costs are those projected to occur from 2021 through 2035.

Data Sources

- The proposed rule.
- The state and federal statutes governing discharges of wastewater (NCGS 143-215.1, federal Clean Water Act).
- The related state and federal regulations (15A NCAC 02H .0100, 02B .0200, and Chapter 40 of the Code of Federal Regulations).

RP.1 Annual Capital Costs/Savings (ACS/S) (Wastewater Dischargers)

(a) Cost Baseline

Discharge Permits. The treatment facilities discharge treated wastewater to surface waters within the Falls Reservoir watershed subject to the terms and conditions of National Pollutant Discharge Elimination System (NPDES) permits administered by the Division of Water Quality. The permit for each facility includes discharge limitations for flow and pollutants of concern, monitoring and reporting requirements, and other site-specific and standard permit conditions. Permits are issued for a maximum of five years. Dischargers must submit design documents to the Division for review and approval and receive an Authorization to Construct (ATC) permit prior to constructing or substantially modifying treatment plants or their component units.

The Durham-North facility also holds a nondischarge permit (WQ0032515) that allows reuse of up to 80,000 gallons per day of reclaimed wastewater. The City's operation is limited to bulk distribution at this time and so does not include an off-site distribution system.

Nutrient Limits. The existing Neuse River Basin Nutrient Management Strategy established annual mass nitrogen allocations and limits for facilities permitted for 0.5 MGD flow or greater and phosphorus concentration limits for those permitted for 0.05 MGD or greater. The three large facilities in the Upper watershed hold nitrogen allocations and are subject to mass limits equivalent to 5.5 mg/L TN at 1995 permitted flows; because SGWASA has since expanded its plant, its TN limit is now equivalent to 3.5 mg/L. The three facilities are subject to phosphorus limits of 2.0 mg/L TP, and the Durham-North plant has an added summer-season TP limit of 0.5 mg/L.

The three small facilities in the Upper watershed received nitrogen allocations under the existing Neuse strategy. They are not subject to nitrogen or phosphorus limits at this time because of their small size. They monitor and report both parameters as a condition of their NPDES permits.

The two facilities in the Lower watershed received nitrogen allocations under the existing Neuse strategy. They do not have nitrogen limits at this time but are subject to phosphorus limits of 2.0 mg/L.

Treatment Facilities. All dischargers currently own and operate wastewater treatment plants and bear the costs of construction, operation, and maintenance of the facilities; disposal of biosolids and other residuals; and permitting and other regulatory activities.

Dischargers in the Upper watershed are already subject to TN limits that, at permitted flows, would require moderate biological nutrient removal (BNR) capability. The Durham-North treatment plant has already upgraded to BNR. The SGWASA plant (formerly owned and operated by NC DHHS) was upgraded to BNR but has since expanded and would now be subject to more stringent treatment requirements at its full design flow. The Town of Hillsborough has not had to upgrade its plant yet, because its actual flows are well below the permitted level, meaning that it can discharge at a higher concentration and still meet its mass TN limit.

All three large plants employ chemical addition and gravity settling to remove phosphorus. None of the smaller plants has nitrogen or phosphorus treatment capability.

In the Lower watershed, the Aqua NC facilities do not have nitrogen treatment capability but remove phosphorus using chemical addition and gravity settling.

(b) Description

Owners of the three large treatment facilities in the Upper Falls watershed will have to expend capital resources to upgrade their facilities to varying degrees in order to meet the Stage 1 nitrogen limits by 2016. They will have to expend additional capital resources for treatment or related measures in order to meet the Stage 2 nitrogen and phosphorus limits by 2036.

In the Lower watershed, Aqua NC will have to expend capital resources to upgrade its facilities to basic BNR capability in order to meet the proposed concentration limits.

See the assumptions below and the 'Step 5: Uncertainties and Alternatives' section of this chapter for more information regarding the nature and limitations of these estimates.

Any new discharger must provide nutrient treatment upon startup of its treatment facilities. Any person proposing a new discharge will be required to acquire sufficient nitrogen and phosphorus allocations from existing dischargers or, alternately, from the nonpoint source load. The latter alternative is conducted through private mitigation banks or the Ecosystem Enhancement Program (EEP). The EEP has proposed to set its offset rates at $22/pound of nitrogen and $140/pound of phosphorus and expects these changes will be adopted prior to adoption of the Falls rules.

(c) Quantify $

Table 4.4 summarizes the estimated costs for treatment plant improvements required to comply with the proposed rule. The estimates cover Years 1-30 (2011-2036) in order to capture costs for the full implementation period. The estimated net present value cost for this period is $19,144,000 per year. As explained in the 'Uncertainties and Alternatives' section, this is intended to represent a high-end estimate of the point source implementation costs.

(d) Quantification Methods and Assumptions

Overview

The Division worked with affected stakeholders to develop calibrated nutrient-sensitive computer models for the Falls Reservoir and its watershed. The models were used to estimate the maximum nutrient loads that the Upper Falls reservoir can receive and still meet the chlorophyll-a water quality standard. The resulting loads were then divided into allowable loads for point and nonpoint sources, and the point source load was further divided to establish individual nitrogen and phosphorus allocations (and, in some cases, limits) for the affected wastewater dischargers.

In the Upper watershed, the resulting allocations and limits are expressed as annual mass loads, which are a measure of both the concentration of nutrients in the wastewater and the amount of wastewater discharged (see again the 'Mass Limit' box, above).

The Division conducted a separate analysis for the Lower watershed. It determined that, given the significant nutrient reductions already required in the Upper watershed, technology-based limits (that is, concentration rather than mass limits) for the Lower Falls dischargers would be sufficient to protect the reservoir.

Approaches to Nutrient Reduction

In order to reduce their nutrient loads, dischargers must either reduce the nutrient concentrations in their treated effluents, reduce their discharge flows, or some combination of the two. Source reduction may also be effective to some degree.

Treatment plant process improvements can significantly reduce nutrient concentrations and are the most direct and reliable means of reducing point source nutrient loads. They have been used almost exclusively to meet limits established under previous nutrient strategies and have proven to be both technically and economically feasible in those cases. Until recently, the limit of conventional nitrogen treatment technology

was considered to be approximately 3 mg/L TN. Since 2007, some Neuse River facilities downstream of Falls Reservoir have treated to 2 mg/L (annual average) with BNR technology.

The Stage 1 concentration limits for the Lower Falls dischargers, at 5.5 mg/L TN and 0.5 mg/L TP, are readily achievable with BNR technology.

Stage 1 mass limits for the Upper Falls dischargers are equivalent to 3.05 mg/L TN and 0.33 mg/L TP at 110% of current flows (an allowance selected for 2016 flows) and should also be achievable using BNR technology, at least initially. The Stage 2 mass limits, on the other hand, are the most stringent the Division has ever proposed, being equivalent to approximately 1.1 mg/L TN and 0.06 mg/L TP at the facilities' full permitted flows. At full flow, these limits are beyond the reach of existing BNR treatment.

Thus, depending on how quickly their flows increase, the Upper Falls facilities may have to go beyond BNR and apply more advanced treatment technologies to meet their interim limits. They will certainly have to do so to meet their final limits.

Advanced treatment technologies exist that can supplement BNR systems. Processes such as reverse osmosis (RO) or ion exchange may be able to reduce nitrogen concentrations to 1 mg/L or lower. However, experience with these technologies in full-scale treatment systems is limited, and their actual performance and true costs in municipal applications are uncertain.

In addition, RO systems work by concentrating pollutants and other materials found in the wastewater, separating the wastewater into a high-quality effluent stream (approximately 75% of the total flow) and a 'reject' stream (25%). The cost estimates are based on using the RO units in series to reduce the amount of reject water, but the total volume could still be on the order of a half million gallons per day. There is considerable uncertainty about how to properly manage this reject stream and, as a result, whether it is feasible to rely entirely on the RO process for nutrient removal. (See 'Step 5: Uncertainties and Alternatives' at the end of this chapter.)

Wastewater reuse can be an effective means of reducing nutrient loads. A portion of the treated effluent – and the nutrients it contains – is diverted away from the discharge and either applied to land or reclaimed for such beneficial uses as irrigation, cooling water supply, or process uses. Opportunities for land application or irrigation in the Falls watershed are limited, due to unfavorable soil conditions and topography; and suitable sites tend to be relatively small and fragmented, making it more difficult (and expensive) to establish distribution lines to those sites.

It appears likely that the point source dischargers in the Upper Falls watershed will ultimately rely on a combination of advanced treatment technology and wastewater reuse to meet their final nutrient limits. While large-scale reuse has not been seen as a cost-effective option in the past, it should become much more desirable when compared with advanced treatment alternatives, which are far more expensive.

Source controls, that is, reducing nutrient contributions at the sources, can, in some cases, be an effective means of reducing a treatment plant's nutrient discharge. None of the municipal plants has industrial users that are major sources of nutrients, so the impact of source reduction efforts, if any, would probably be relatively small.

Cost Estimate Methods: Overview

Owners of the five large facilities have all indicated that they will rely on process improvements as their first means to reduce nutrient loads. Owners of the three large facilities in the Upper watershed have indicated that, at this time, they consider RO the most likely technology for meeting the proposed limits, despite its shortcomings and uncertainties.

For the purposes of the cost estimates that follow, the Division assumes that:

- the Lower Falls dischargers will install standard BNR treatment to meet their Stage 1 concentration limits by 2016.
- the three large Upper Falls dischargers will upgrade their existing facilities from currently required

treatment levels to full BNR capability, with deep-bed filtration and carbon addition (or similar), by 2016 in order to reach approximately 2 mg/L TN.

- the Upper Falls dischargers will install MF-RO treatment to reach TN levels less than 2 mg/L and meet Stage 2 limits.
- planning and design for Stage 1 improvements will occur in 2012-13 and construction will follow in 2014-2015.

Advanced treatment will also be necessary to meet Stage 1 mass limits if a facility's flows increase significantly. Because they are mass limits, the equivalent concentrations to be met will tighten as flows increase beyond 110% of current flows. As a result, these dischargers may have to install some of the improvements selected to meet Stage 2 limits much earlier than 2036 in order to continue to comply with their Stage 1 mass limits. It appears that, by the time the facilities' flows reach approximately 75% of their permitted levels, BNR processes will no longer be sufficient to meet the Stage 1 mass limits.

The Division assumes that:

- in the aggregate, wastewater flows for the Upper Falls dischargers will increase linearly from current levels (approximately 50% of permitted flows) to full permitted flows by 2030 (20 years)
- as a result, membrane filtration and reverse osmosis units (MF-RO) will be added incrementally over that time to meet Stage 1 limits
- MF-RO capacity is assumed to be added in a step-wise fashion, as described below.
- the large dischargers will continue to use chemical addition to reach 0.5 mg/L TP and will use tertiary filtration and/or the MF-RO systems to meet more stringent phosphorus limits.

These cost estimates are based entirely on a treat-and-discharge approach and do not include reuse options due to the great uncertainty over the available options and their feasibility. Some reuse costs are presented in the 'Uncertainties and Alternatives' section for illustration purposes.

Cost Estimate Methods: Conventional Treatment

Cost estimates for BNR process improvements for nitrogen removal and chemical treatment for phosphorus removal are based primarily upon the methodologies and estimates reported for 540 wastewater treatment plants in the Chesapeake Bay watershed (Chesapeake Bay Program, 2002). Many of those plants are subject to annual mass nutrient limits equivalent to 3.0 mg/L TN and 0.1 mg/L TP as of this year (2010).

The Chesapeake estimates are based on cost data from actual project bids as well as detailed cost estimates that had already been prepared for the affected facilities. The task force used the data to generate cost curves for large and small facilities, TN and TP improvements, and capital and O&M costs.

The task force assumed that most dischargers would make incremental improvements in order to meet the new nutrient limits by 2010. They identified four tiers of nutrient treatment, ranging from "none" in Tier 1 to full 2010 compliance in Tier 4 (Table 4.5), and selected the plant improvements most likely to be used to reach each tier (Table 4.6). The team then calculated, for each facility and each tier, the capital costs and the associated operations & maintenance (O&M) costs. Table 4.7 shows how the Chesapeake tiers correspond to the nutrient targets for the Falls Reservoir point sources (note, however, that the Tier 4 processes have been found to reach 2 mg/L TN, see discussion below). Cost estimates in the Chesapeake report were developed for three groups to reflect varying treatment requirements and economies of scale: large municipal facilities (those $\geq$ 0.5 MGD), large industrial facilities (also $\geq$ 0.5 MGD), and smaller facilities. Nitrogen and phosphorus treatment generally require different treatment units and also have separate O&M needs, so the costs for nitrogen and phosphorus treatment improvements were estimated separately. The report noted that its estimates are reasonable budgetary estimates on a watershed scale but that they are not reliable on a facility-by-facility basis.

Total Nitrogen. It has generally been accepted in recent years that municipal treatment facilities can reduce total nitrogen to approximately 3 mg/L by modifying their existing biological systems to include new anoxic

units and supplementing the whole with deep-bed denitrification filters and methanol feed (or other carbon source). In North Carolina, similar plants have begun to reach 2 mg/L in recent years. It appears that, given the cost of the MF-RO process, this has gained some degree of acceptance as the new limit of conventional BNR technology.

Total Phosphorus. A variety of treatment technologies is available for phosphorus removal and includes biological, chemical, and physical (filtration) processes. Municipal activated sludge treatment systems can generally reduce total phosphorus to approximately 0.5 mg/L TP using chemical addition and gravity settling and to 0.1 mg/L TP with low-pressure membrane filtration (MF) (Chesapeake Bay Program, 2002). Chemical addition followed by tertiary filtration is reported to consistently reach 0.01 mg/L TP (USEPA, 2007, in Hartman et al., 2007). BNR can reportedly reduce phosphorus to 1-3 mg/L, and enhanced biological phosphorus removal can reach levels of 0.3 mg/L TP (Freed 2007, in Hartman et al., 2007) or lower.

The capital cost estimates presented here assume that all facilities with limits equivalent to less than 0.5 mg/L TP will supplement chemical treatment with. MF technology is also used as a pretreatment step prior to reverse osmosis treatment of wastewater.

All large dischargers in the Upper Falls watershed already use chemical addition to meet phosphorus limits of 2.0 mg/L and, at Durham-North WWTP, a summer limit of 0.5 mg/L. They will not have to make further upgrades to reach 0.5 mg/L but will face increased operating expenses due to greater chemical use and sludge disposal costs. (Durham has indicated it will make improvements in its chemical addition facilities as part of its Falls upgrades; the estimates in this analysis include costs for carbon feed (at denitrification filters) where necessary but do not specifically include improvements to the existing feed system.)

All large facilities in the Upper and Lower Falls watershed will have to expend capital resources for plant improvements in order to meet their Stage 1 nitrogen limits. The Durham-North and SGWASA facilities already have BNR systems but require some improvement to maximize nitrogen removal. The Hillsborough facility must upgrade to BNR to meet its limits. **The cost estimates for BNR improvements do not include those measures that would already be required at full permitted flow to meet the facilities' existing TN limits.**

These facilities must take additional steps to meet their Stage 1 limits if their flows increase significantly between 2016 and 2036; and, depending on what improvements are made in that time, they may have to take further steps to meet their Stage 2 limits. Figure 4.1 show the relation between nutrient reduction targets, discharge flows, and discharge concentrations for nitrogen in the Upper Falls watershed.

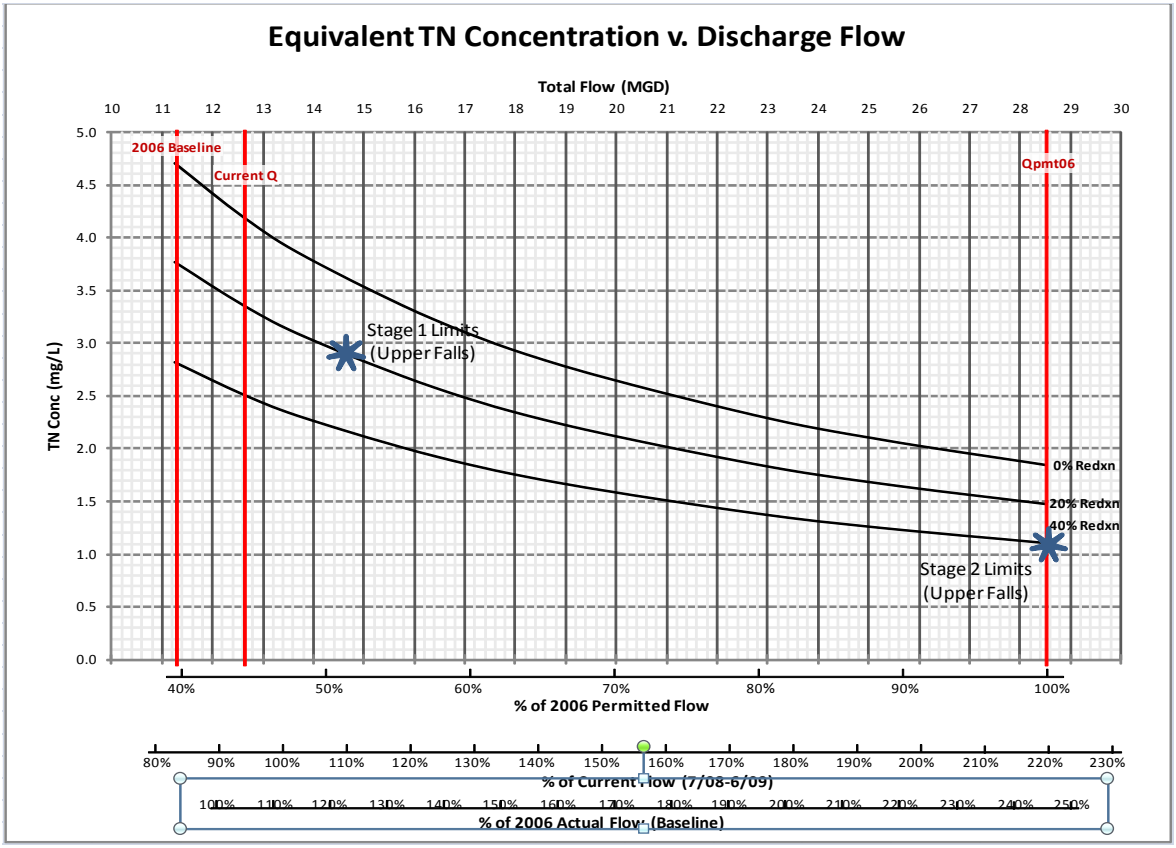
The Division assumes that the Upper Falls facilities will meet Stage 1 limits by upgrading to full BNR capability, including addition of denitrification filters and carbon addition, to reach approximately 2 mg/L TN. Lower Falls facilities will be able to meet their limits with more basic BNR configurations.

Cost estimates for Stage 1 improvements are based on cost curves from the Chesapeake Bay report and reflect the costs of upgrading each facility from its existing treatment configuration to the necessary BNR level by 2016 (see the appendix for a summary of the cost curves' equations). Costs include a 30% allowance for implementation costs, which in turn include engineering, construction management, legal support, and bonding and administrative fees. The sum of construction and implementation costs is the capital cost.

It is assumed that the Upper Falls facilities will meet final phosphorus limits using chemical addition and either tertiary filtration (sand media) or membrane filtration. They could also include biological phosphorus removal as part of their BNR upgrades, in which case the costs would generally be covered under the BNR estimates.

Dischargers in the Lower watershed should readily meet new phosphorus limits by increasing chemical dosages, without capital improvements.

Figure 4.1
Correlation of TN Reductions, Discharge Flows, and Equivalent Concentration, Upper Falls Watershed



Cost Estimate Methods: Advanced Treatment

Cost estimates beyond 2016 assume that the large Upper Falls dischargers will rely on MF-RO technology to meet the proposed limits. Experience with and cost data for membrane filtration and reverse osmosis processes are limited. Estimates are based primarily upon unit treatment costs provided by consultants for Durham and Hillsborough: $18/gallon of treatment capacity for capital costs. This figure includes costs for design and construction of MF-RO facilities, treatment units, and related piping, utilities, and instrumentation.

It is also assumed that flows will steadily increase from current levels (50% of permitted flows) to full permitted flows by 2031 and that membrane filtration and reverse osmosis units will be added incrementally over that time: 20% of permitted capacity in 2020, another 30% in 2025, and the final 50% in 2030. The conceptual approach is illustrated in Figure 4.2.

Estimates also assume that the first 20% increment of MF-RO capacity will require 50% of the total capital investment, the next 30% requires another 20% investment, and the last 50% requires the remaining 30% of investment.

The estimates assume that reject water will undergo MF-RO twice more in succession in order to reduce reject water flows. Given a total flow 28.5 MDG of the three Upper Falls facilities and reject rate of 25% for each MF-RO treatment, the three dischargers would need to install a total RO capacity of 1.31 MGD for each 1 MGD of influent wastewater flow and manage a combined reject flow of 0.45 MGD. Using these assumptions, the three facilities would generate 16,000 gallons reject per 1 MGD of influent flow.

It is assumed that the dischargers will each establish a reuse program for this purpose.

Other Costs - New Dischargers

The DWQ is not aware of plans for any new discharges in the watershed. However, the rule does not prohibit such a discharge in the Upper watershed.

Any person proposing a new discharge of domestic wastewater would (1) have to acquire nitrogen and phosphorus allocations (not to exceed the mass loads equivalent to 3.0 mg/L TN and 0.1 mg/L TP at design flow) and (2) bear the costs for both BNR and advanced nutrient treatment processes necessary to meet the resulting permit limits.

The Ecosystem Enhancement Program (EEP) has proposed allocation rates of $22/lb TN and $140/lb TP. The proposed wastewater rule for Falls Lake requires a payment for 30 years worth of nutrient offsets and sets the cost of nitrogen allocation at 200% of the EEP's rate, or $44/lb TN. At these rates, the cost of acquiring the maximum allocations for a new 0.5 MGD facility treating domestic wastewater would be as follows:

3.0 mg/L TN x 0.5 MGD x 8.34 lb/gal x 365 d/yr x $44/lb x 30 yr = $6,027,300 TN allocation

0.1 mg/L TP x 0.5 MGD x 8.34 lb/gal x 365

$6.7 million for TN & TP allocation

Using the methods described later in this section, the incremental capital costs of BNR technology would be approximately $6.4 million (2010 dollars). At $18/gallon of capacity, MF-RO units would cost $9 million.

Thus, the total capital costs associated with nutrient controls for a new 0.5 MGD discharger would be about ($6.7 + $6.4 + $9) million = $22.1 million.

(e) Specific Assumptions

The capital costs for conventional BNR upgrades are based primarily on the Chesapeake Bay report as described above. The assumptions described in the report are incorporated into this fiscal note.

All cost data (and cost curves) in the Chesapeake Bay report cited were standardized to July 2000 dollars using the Engineering News-Record Building Cost Index ($CCI_{July\ 2000}$ = 6400). For the purposes of the Falls cost estimates, costs were re-adjusted to 2010 dollars using a $CCI_{March\ 2010}$ = 8761.

Wastewater flows at the Upper Falls facilities are assumed to reach permitted levels in 20 years (2031).

Reject waters will be reused or land-applied.

Present value costs are calculated using a 7% per annum discount rate over the evaluation period.

Annual inflation rates for the evaluation period are based on Consumer Cost Index projections provided by OSBM.

(f) Data Sources

- "Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed," Chesapeake Bay Program, Nutrient Reduction Technology (NRT) Task Force, 2002. Available for download at http://archive.chesapeakebay.net/pubs/NRT_REPORT_FINAL.pdf
- Personal communication with Durham-North and Hillsborough WWTP staff and their consultants, 2010.
- Hartman, Pamela, and Joshua Cleland, ICF International, "Wastewater Treatment Performance And Cost Data To Support An Affordability Analysis For Water Quality Standards," prepared for Montana Department of Environmental Quality, 2007. Available for download at http://www.deq.state.mt.us/wqinfo/standards/PDF/Nutrient%20Treatment%20Cost%20Data_053107.pdf

Figure 4.2
Projected Implementation Approach and Timeline

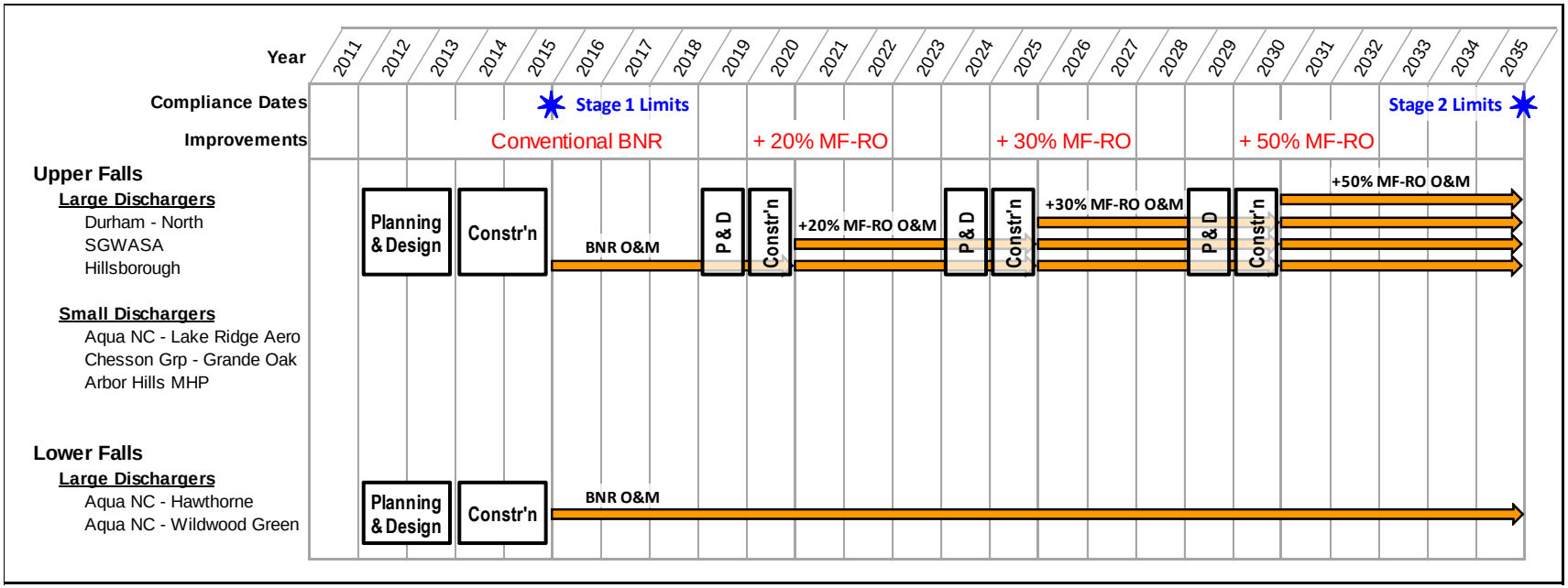


Table 4.5
Tiers Used For Chesapeake Bay Point Source Cost Estimates [1]

Discharger Category	Tier 2	Tier 3	Tier 4
Municipal WWTPs ≥0.5 MGD	TN = 8.0 mg/L TP = 1.0 mg/L Or permit limit if less	TN = 5.0 mg/L TP = 0.5 mg/L Or permit limit if less	TN = 3.0 mg/L TP = 0.1 mg/L
Municipal WWTPs <0.5 MGD	TN and TP = 2000 concentrations	TN and TP = 2000 concentrations	TN = 8.0 mg/L TP = 2.0 mg/L Or 2000 conc. if less

Footnote
[1] Concentrations are annual average values, equivalent to annual mass limits at permitted flows.

Table 4.6
Treatment Technologies Assumed for Chesapeake Bay Tiers and Falls Strategy

	Chesapeake Bay Approach			Falls Strategy
Nutrient	**Tier 2**	**Tier 3**	**Tier 4**	**Stage 2**
Nitrogen	Nitrification, basic denitrification	Improved denitrification, clarification, secondary anoxic zone	Deep-bed denitrification filters	Reverse osmosis (MF pretreatment)
Phosphorus	Chemical precipitation	Chemical precipitation	Chemical precipitation with membrane filtration	Chemical precipitation with membrane filtration

Table 4.7
Equivalence of Chesapeake Treatment Tiers and NC Nutrient Strategy Requirements

Nutrient Strategy	Tier 2	Tier 3	Tier 4	Beyond Tier 4
Chesapeake Bay Program			TN & TP (2010)	
Dischargers ≥ 0.5 MGD to NSWs [1]	TP (2003)	TN (2003)		
Neuse River [2] Upper (Falls) Lower	 TP (2003) TP (2003)	TN (2003)	 TN (2003)	
Jordan Reservoir Upper New Hope Lower New Hope Haw River	 TP (2010)	 TP (2010), TN (2016) TN (2016)	TP (2010), TN (2016)	
Falls Reservoir		TP (Stage 1, 2016)	TN (Stage 1, 2016) TP (Stage 2, 2036)	TN (Stage 2, 2036)

Footnotes
[1] Default limits from the Clean Water Responsibility Act (1997); concentrations are the basis for annual mass limits. NSW = surface waters classified as Nutrient Sensitive Waters.
[2] Municipal WWTPs ≥ 0.5 MGD

RP.2 Annual Operating Costs/Savings (AOC/S) (Wastewater dischargers)

(a) Cost Baseline

All dischargers currently own and operate wastewater treatment plants and bear the costs of facility operation and maintenance (O&M). The five large facilities (Table 4.1) are already subject to Total Phosphorus limits (2.0 mg/L concentration limit for most) and operate treatment systems designed to meet those limits.

Two of the three large facilities in the Upper watershed (Durham-North and SGWASA) are subject to mass TN limits under the existing Neuse nutrient strategy and have made facility improvements to meet those limits. They will have to make additional improvements to meet the proposed Stage 1 and then Stage 2 limits. The Hillsborough facility and both Aqua NC facilities in the Lower watershed lack nitrogen treatment and will have to make further upgrades to meet proposed limits.

(b) Description

Each large discharger will bear increased operation and maintenance costs for its particular process improvements. Operation and maintenance costs will vary depending on the type and size of treatment system and the improvements required to meet the proposed nutrient limits.

All of the affected facilities are subject to permit limits on total phosphorus and employ chemical addition and gravity settling to meet those limits. The same treatment process can treat to approximately 0.5 mg/L TP when chemical feed rates are increased. The higher feed rates, in turn, result in increased sludge production and related disposal costs. Supplemental treatment is required to meet lower limits. Cost estimates for such cases are based on the use of chemical addition followed by membrane filtration. The O&M costs for improved phosphorus removal include those for incremental operator labor for nutrient treatment, increased chemical use, increased sludge production, and (if membranes are used) membrane maintenance and replacement.

The large treatment facilities in the watershed already nitrify their wastewater (converting ammonia to nitrate nitrogen) to meet ammonia limits. The Durham-North and SGWASA facilities also denitrify (converting nitrates to nitrogen gas) to meet Total Nitrogen limits. The added O&M costs for improved nitrogen removal include incremental operator labor, methanol addition, added solids production, energy use, and maintenance.

(c) Quantify $

Table 4.4 summarizes the estimated 2011-2035 operations and maintenance costs associated with treatment plant improvements required to comply with the proposed rule.

(d) Quantification Method

O&M cost estimates for the affected dischargers are developed in a manner similar to the capital costs. For each year in the implementation period, costs are calculated based on which new treatment processes (if any) are in operation in that year. Estimates include, where considered necessary, costs of additional chemicals, energy, maintenance, increased solids handling, and other operator labor.

O&M costs for BNR improvements are based on the Chesapeake Bay report cited below. Estimates for MF-RO systems are based upon unit treatment costs provided by consultants for Durham and Hillsborough: $1.75/ 1,000 gallons treated for operations and maintenance (O&M) costs.

<u>New Discharges</u>. The DWQ is not aware of plans for any new discharges in the watershed. However, the rule does not prohibit such a discharge in the Upper watershed.

O&M costs for a new 0.5 MGD facility treating domestic wastewater

Any person proposing a new discharge of domestic wastewater would incur costs of operating the nutrient treatment units required under this rule. Using the Chesapeake Bay cost curves, the annual O&M costs to achieve Tier 4 for TN (3.0 mg/L) and Tier 3 for TP (0.5 mg/L) would be $98,000/year. Assuming that MF-RO would be installed to reduce TP to 0.2 mg/L, the added O&M

costs at full capacity would be $1.75/1,000 gal x 500,000 gallons/day x 365 days/year, or $319,000/year. The combined O&M costs would be approximately $417,000/year.

(e) Assumptions

Assumptions regarding the implementation schedule are the same as for the capital cost estimates (RP1). O&M costs assume treatment units operate at full capacity once installed.

Additional chemical treatment and installation of basic BNR are assumed to not have appreciable labor requirements. Curve for full BNR in Chesapeake report is based on 4 hrs/day for 1 MGD plant, 6 hr/day for 10 MGD, and 12 hr/day for 30 MGD. The report used a rate of $30/hr for incremental salary and benefits (adjusted to $40.65/hr using ENR CCIs for 2000 and 2010, a conservatively high adjustment).

Present value costs are calculated using a 7% per annum discount rate over the evaluation period.

Annual inflation rates for the evaluation period are based on Consumer Cost Index projections provided by OSBM.

(f) Data Sources

- "*Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed*," Chesapeake Bay Program, Nutrient Reduction Technology (NRT) Task Force, 2002. Available for download at http://archive.chesapeakebay.net/pubs/NRT_REPORT_FINAL.pdf.
- Personal communication with Durham-North and Hillsborough WWTP staff and their consultants, 2010.

RP.3 Annual Planning Costs/Savings (APC/S) (Wastewater dischargers)

(a) Cost Baseline

Some amount of planning is an inherent requirement in effectively managing a wastewater treatment facility.

(b) Description

The proposed rule does not require the dischargers to perform additional annual planning. However, project design and planning costs will be incurred for nutrient-related process improvements.

(c) Quantify $

Refer to Table 4.4 and the narrative in RP1 above for information on the project planning and design costs for treatment plant improvements.

(d) Quantification Method

Consistent with the Chesapeake Bay project, an allowance equal to 30% of the capital cost estimates is made for "program implementation," including engineering, design, construction management, legal, bonding, and administrative/ permitting fees, and other staff time. This same allowance is made for the advanced treatment estimates; that is, the $18/gallon capital cost includes construction costs plus 30% for the implementation allowance.

(e) Assumptions

Any additional annual planning associated with the operation of more complex treatment processes is taken into account in the O&M cost estimates.

(f) Data Sources

- "Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed," Chesapeake Bay Program, Nutrient Reduction Technology (NRT) Task Force, 2002. Available for download at http://archive.chesapeakebay.net/pubs/NRT_REPORT_FINAL.pdf

- Personal communication with Durham-North and Hillsborough WWTP staff and their consultants, 2010.

RP.4 Regulatory Transaction Costs/Savings (RTC/S) (Wastewater dischargers)

(a) Cost Baseline

Existing regulations require that owners of wastewater treatment facilities obtain NPDES permits for their wastewater discharges from the Division and operate in accordance with those permits. Existing regulations also require owners to obtain an "authorization to construct" permit from the Division prior to constructing or modifying any wastewater treatment units.

(b) Description

The proposed rule does not affect the requirements or costs for NPDES permit coverage. The proposed rule will require most treatment facility owners to obtain at least one Authorization to Construct (ATC) permit for nutrient-related treatment plant improvements. However, there is no fee for ATC permits at this time.

(c) Quantify $

N/A

(d) Quantification Method

N/A

(e) Assumptions

Existing wastewater treatment facilities will require at least one ATC permit for plant modifications necessary to meet the new nitrogen and phosphorus limits. Staff and consulting time spent in obtaining the ATC permits is already included in the Planning estimate.

(f) Data Sources

- NCGS §143-215.1 (a), 15A NCAC 2H .0105
- "Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed," Chesapeake Bay Program, Nutrient Reduction Technology (NRT) Task Force, 2002. Available for download at http://archive.chesapeakebay.net/pubs/NRT_REPORT_FINAL.pdf

RP.5 Other Costs/Savings (OtC/S) (Wastewater dischargers)

(a) Cost Baseline

(1) Owners of the affected wastewater treatment facilities already hold NPDES permits and operate the facilities according to the terms and conditions of the permits. Those terms and conditions include requirements for the monitoring and reporting of the discharge. Existing standards already require that the affected treatment plants be staffed with operators adequately qualified to operate their nutrient treatment processes.

(2) Owners of the affected wastewater treatment facilities already hold NPDES permits and operate according to the terms and conditions of those permits. All were assigned nitrogen allocation under the Neuse River nutrient strategy, which allows dischargers to transfer allocation among themselves (e.g., buy/ sell or lease), at whatever cost they agree on. Such transfers are conducted in terms of 'delivered' or 'estuary' allocation in order to account for differences in delivery rates from different parts of the basin and ensure that the transfer does not exceed the allowable load at the estuary.

(b) Description

(1) The proposed rule will result in increased monitoring requirements and costs for some facilities. It may also result in increases in pretreatment costs for industrial contributors of nutrients to municipal WWTPs.

(2) Current discharge allocations for the large Upper watershed dischargers far exceed those under the proposed rule (444,262 lb/yr vs. 95,858 lb/yr). When the more stringent limits in this rule become effective, they will govern each facility's nitrogen discharge and the remainder of the each allocation will become 'reserve' allocation and no longer be counted toward permit limits. Under the Neuse River strategy, the dischargers could sell or lease their reserve allocation (348,404 lb/yr total, equivalent to 34,840 lb/yr as estuary allocation) to facilities downstream of Falls Dam.

However, instream monitoring above the Neuse estuary has yet to show any reduction in the nitrogen load (2003 goal: 30% reduction). The Division is concerned that allowing these trades would result in further nutrient impacts at the estuary and is considering whether to prohibit transfers from the Falls watershed to the lower river basin.

(c) Quantify $

(1) Unable to quantify.

The resulting costs will depend on such factors as:

- the size of each facility,
- the design and complexity of the existing treatment units,
- the rating of the existing facility,
- the waste characteristics of the industrial contributors, and
- the existing compliance record and the experience of the owners.

Increased costs may include added compliance costs in the short-term and increasing the pretreatment levels required for industrial contributors.

(2) Cannot include the potential savings at this time, due to uncertainty that the trades will be allowed. But, using the market price seen in recent trades, this amount of allocation would be worth approximately $17,400,000.

(d) Quantification Method

(1) N/A

(2) 34,840 lb/yr estuary allocation x $500/lb ≈ $17,400,000

(e) Assumptions

(1) N/A

(2) Sales price of $500 per lb/year of estuary allocation, based on recent transactions in the Neuse basin.

(f) Data Sources

- Fiscal Analysis: Neuse River Nutrient Sensitive Waters (NSW) Management Strategy, 1997.
- Transaction records, Neuse basin allocation sales (2009).

4-B. Implementing Agencies

IA.0 North Carolina Division of Water Quality (DWQ)

The implementing agency affected by this rule is the NC Division of Water Quality (DWQ), specifically, the Division's Surface Water Protection and Construction Grants & Loans Sections.

The Surface Water Protection (SWP) Section administers various water quality programs. These include the NPDES and ATC permit programs for wastewater treatment and disposal systems. The proposed rule potentially affects both regional and central offices. Central office staff will review permit applications, incorporate new nutrient control requirements into the affected permits, and develop policy, as necessary, in order to ensure proper implementation of the proposed rule. Regional office staff will assist with the reviews and provide compliance oversight, conduct on-site investigations to develop permit recommendations, etc.

The Construction Grants and Loans (CG&L) Section administers the Authorization to Construct permits program for facilities discharging to surface waters. CG&L staff will conduct technical reviews of the engineering design and plans and specifications for any plant improvements required to meet nutrient limits and will issue ATC permits for the construction of those improvements.

General Baseline
DWQ currently administers the wastewater permitting programs for NPDES discharges and for land application of treated wastewater. These programs require wastewater treatment plant owners and operators obtain permits prior to initiating construction of treatment systems or disposal of treated wastewater (including sewer line construction). Existing staff currently review and issue permits for wastewater treatment and disposal.

Assumptions
N/A

Data Sources
- Review of current wastewater permitting programs.

IA.1 Regulatory Development Costs/Savings (RDC/S)

(a) Cost Baseline
DWQ staff administer permit and other programs and conduct rulemaking as a regular part of its program activities.

(b) Description
Development and implementation of the proposed rule represent limited additional workload to the Division. All such activities will be undertaken by existing staff. Opportunity costs for these activities are included in the 'New Development' chapter.

(c) Quantify $
See 'New Development' chapter.

(d) Quantification Method
See 'New Development' chapter.

(e) Assumptions
The existing staffing levels are sufficient to handle the workload associated with development and implementation of the rules.

(f) Data Sources
N/A

IA.2 Monitoring & Recordkeeping Costs/Savings (MRC/S)

(a) Cost Baseline
The Surface Water Protection Section currently monitors permit compliance and maintains records of its permitting and compliance monitoring activities under existing standard operating procedures.

(b) Description
The proposed rule will not cause any discernible increase in the Division's monitoring and recordkeeping workload.

(c) Quantify $
Negligible opportunity cost of staff time.

(d) Quantification Method
N/A

(e) Assumptions
The existing staffing levels are sufficient to handle the workload associated with the Division's monitoring and recordkeeping costs.

(f) Data Sources
N/A

IA.3 Permitting Costs/ Savings (PC/S)

(a) Cost Baseline
(1) The Surface Water Protection Section currently issues NPDES permits in the watershed under existing standard operating procedures. At times, the Section must apply more stringent limits in a permit in order to protect surface water quality. Such cases can represent considerable workload for Section staff, as they must document the rationale for the new limits and defend the permit against formal or informal challenges.

(2) The Construction Grants and Loan Section currently reviews design documents and, upon approval, issues ATC permits for the construction or substantial modification of treatment plants or their component units.

(b) Description
(1) The proposed rule will establish discharge limits calculated to protect water quality in the Falls Reservoir. This will result in consistent treatment of the dischargers and will relieve the Section of the need to develop protective permit limits on a case-by-case basis. Thus, the proposed rule will likely reduce the amount of time SWP Section staff must spend to develop and implement protective nutrient limits in its NPDES permits in the Falls Reservoir watershed and to defend those permits.

(2) Large facilities in both the Upper and Lower Falls watershed will have to obtain ATC permits for each round of treatment plant improvements undertaken to meet the requirements of this rule.

(c) Quantify $
(1) Opportunity costs for DWQ staff are addressed in the New Development chapter.

(2) $35,000 opportunity costs at present rates, realized over the 20-years period following the effective date of the rule.

(d) Quantification Method
(1) N/A

(2) This cost represents an opportunity cost to the Division. Tasks are part of the staff's existing program responsibilities and would be integrated into existing workloads.

(e) Assumptions

(1) Savings will not be discernible, because staff will re-direct its attention and address other priority needs within the NPDES program.

(2) 5 WWTPs x 4 ATCs = 20 ATCs. ATCs include 1 for BNR improvements in Stage 1 (2012-2013) and 3 for MF-RO additions in Stage 2 (2019, 2024, 2029).

Design review and ATC issuance = 50 hrs each = 1,000 hrs, or about 0.5 FTE over about 20 years.

Salary & benefits = $70,000/yr, based on budgeting experience for existing positions.

(f) Data Sources

(1) N/A

(2) Workload experience with ATC program, budgeting experience for existing positions.

IA.4 Inspection/ Enforcement Costs/Savings (IEC/S)

(a) Cost Baseline

The Water Quality Section currently inspects point sources and enforces NPDES permits in the basin under existing work plans. There will be no new inspection and enforcement costs associated with this proposed rule.

(b) Description

N/A

(c) Quantify $

N/A

(d) Quantification Method

N/A

(e) Assumptions

N/A

(f) Data Sources

N/A

IA.5 Other Costs/Savings (OtC/S)

(a) Cost Baseline

Technical assistance associated with the proposed rule would be provided to local governments by existing staff. Therefore, there will be no new costs associated with this proposed rule.

(b) Description

Opportunity cost of staff time.

(c) Quantify $

Opportunity costs for DWQ staff are addressed in the New Development chapter.

(d) Quantification Method

N/A

(e) Assumptions

N/A

(f) Data Sources
N/A

Step 5: Uncertainty and Alternatives

It is difficult to prepare sound and defensible cost estimates for the wastewater requirements in the Upper Falls watershed because (1) the proposed nutrient limits are exceptionally stringent and (2) the schedule for meeting those limits is exceptionally long – 25 years, if the rule is adopted in January 2011 as planned. In fact, the implementation schedule is as long as it is because of uncertainty about how the dischargers will meet their nutrient limits.

Uncertainty Regarding Advanced Treatment Technologies. The nutrient reductions required in the Upper Falls watershed are the most ambitious ever proposed in North Carolina and come on top of significant reduction requirements already established for the Neuse River basin. The resulting nutrient limits for the Upper Falls dischargers are the most stringent ever proposed, equivalent to approximately 1.1 mg/L TN and 0.06 mg/L total phosphorus TP at the facilities' full permitted flows.

Nitrogen removal technology has existed for several decades but was used only rarely until the mid-1990s. Performance continues to improve as the technology evolves and operators and their consultants become more expert in operating the new systems. The accepted limits of BNR technology have decreased from 6-8 mg/L TN in the late 1980s and early '90s to 3.5 mg/L in the late '90s, then to 3.0 mg/L in the last decade. Today it appears that 2.0 mg/L TN is attainable under certain conditions – about a third of the limits applied less than 20 years ago.

It appears that the Upper Falls dischargers will rely on conventional BNR processes to remove as much nitrogen as possible and then apply more advanced technologies to get the remaining reductions. All three of the Upper Falls dischargers have evaluated the available technologies and concluded (for now, at least) that reverse osmosis (RO) systems are the most likely to effectively meet the proposed nutrient limits. (Advanced treatment technologies are not required to meet nutrient limits proposed for the Lower Falls dischargers.)

Experience with these technologies in full-scale treatment systems is limited, and actual performance and true costs in municipal applications are uncertain. RO systems are rarely used to treat municipal wastewater on this scale and, as a result:

- performance data for nutrient removal are limited, and
- impacts on the rest of the plant's operations are uncertain; for example, how the RO process will affect solids handling and disposal, side-stream management, and general operations.

Capital costs for RO are high (perhaps $16-18/gal of treatment capacity, compared to $1-3/gal for BNR upgrades), in part because extensive pretreatment such as membrane filtration (MF) is necessary to maximize the service life of the RO units. Both the MF and RO units are energy-intensive, so their operating costs are high as well (and potentially volatile).

The $18/gal figure used for capital costs and the $1.75/1,000 gal operating figure provided by municipal staff and their consultants are based largely on knowledge and experience with water treatment systems – certainly not with 20 MGD municipal wastewater systems. As a result, the estimates for the Durham-North WWTP are more uncertain than for the SGWASA and Hillsborough plants, which are themselves speculative.

The 30% allowance for planning and design is a common figure but is itself variable and may compound any deviations in the capital cost estimates. And, while it is commonly used in cost estimates for

treatment plant capital improvements, the allowance may be overly conservative for the relatively straightforward installation of RO units.

In producing its high-quality effluent (or 'permeate'), the RO process concentrates the wastewater's pollutants into a 'reject' wastestream. Approximately 75% of the through- flow is permeate, and the remaining 25% is reject water. It is possible to further concentrate this reject stream and reduce its volume with additional RO treatment, but the volume could still be on the order of half a million gallons per day.

Reject water is sometimes suitable for reuse or land application. In other states (but not North Carolina), it can discharged to the ocean or to injection wells. It is not yet clear how best to treat and dispose of the reject in this application. Nor is it clear where the cost of additional RO treatment for reject water (to reduce reuse requirements) equals the cost for reusing the reject water (to reduce costs of treatment). The estimates provided here do not quantify the costs of reject disposal. However, they are based on conservative assumptions and are intended to at least locate the high end of the range of possible costs.

The cost estimates in this chapter do not presume any improvements in either BNR or advanced treatment technologies over the next 25 years. However, given the trend in BNR performance over the past 15-20 years described earlier in this chapter, we may well expect that more effective technologies will be found in the coming years.

The estimates do not include the potential value of the effluent from the MF-RO processes. This permeate will certainly be of much higher quality than necessary to satisfy wastewater reuse requirements (see discussion below), but we do not know its specific chemical characteristics and so cannot speculate as to other beneficial uses it may have. It seems clear that the dischargers will have invested a great deal of public monies to create this new water resource and will likely not want to simply discharge it without getting some benefit from their investments.

It is also reasonable to expect that available technologies will become more affordable. A 2004 review by the Chesapeake Bay Program noted that nutrient reduction technology is expanding at an exponential rate: 8 mg/L TN was state-of-the-art for that region and cost about $35/lb TN removed; by 2004, 3 mg/L was entirely feasible and cost less than $10/lb removed. The review also noted that a study of 66 major municipal plants in Maryland concluded that the costs of reaching 3 mg/L TN today would be 32% less than estimated in the previous Chesapeake Bay study. When Virginia's Hampton Roads Sanitation District updated the estimates for its eight facilities, the estimates came in 23% less than the original estimates. And these improvements came within a period of four years from the original cost study.

Given the extremely high cost estimates for advanced treatment at this time, it seems likely that the potential cost of meeting the proposed nutrient limits may itself spur development of more effective and more affordable processes in both areas of technology.

Alternative to Stage 1 Mass Limits, Upper Falls Watershed. The Division originally proposed that the Upper Falls dischargers be subject to annual average concentration limits of 3.0 mg/L TN and 0.1 mg/L TP in Stage 1. The City of Durham and SGWASA requested that these be changed to mass limits so that they would have the option of trading nutrient allocations during Stage 1. The Division agreed to the change, and limits representing 20% TN and 40% TP reductions were chosen. Meeting the Stage 1 limits presents a significant and expensive challenge to the dischargers.

A return to the concentration limits first proposed would still require the dischargers to achieve substantial nutrient reductions by 2016. But, because those limits would be readily achievable with BNR technologies throughout Stage 1, they would defer most of the costs projected for 2016-2030, which would reduce the net present value estimate of the cost by approximately $134 million, or about 28%. They would also allow much more time for the dischargers to seek out and implement a strategic course of action for meeting the Stage 2 limits by 2036. And they would allow the dischargers to take advantage of any new developments in nutrient treatment technology that occur in the meantime.

Sensitivity of Assumed Values. Key values used in the calculation of costs include the capital and O&M costs for MF-RO improvements ($18/gallon and $1,750/ 1,000 gallon, respectively). Figure 4.3 presents the results of a cursory look at the sensitivity of these assumptions.

Costs are most sensitive to the unit capital cost for MF-RO treatment, which is, as already noted, somewhat speculative in nature for this application. Differences in any or all of these measures from their actual values could result in widely varying outcomes for implementation of the rule.

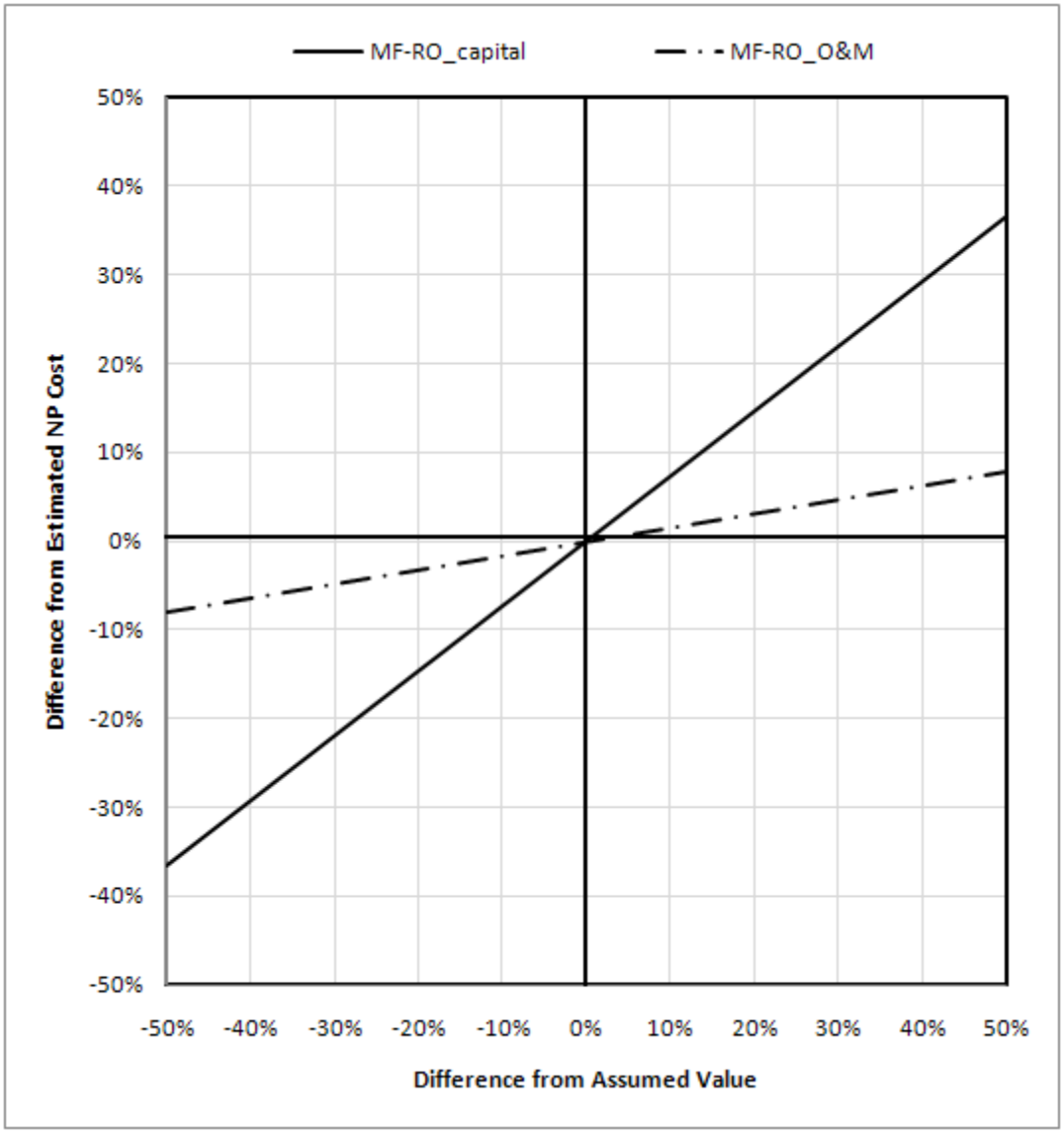
Disposition of Reserve Allocations. The proposed rule effectively inactivates a large portion of the nitrogen allocation assigned to the Upper Falls dischargers under the existing Neuse River nutrient strategy. The dischargers could sell or lease this allocation to downstream dischargers and use the proceeds to help fund treatment plant improvements necessary under the new rule. However, the Division is concerned that TN reductions reported in the Neuse River basin do not appear to have reduce loads to the estuary as was intended. Thus, it is considering whether to disallow any such transfers downstream or delay them until that issue is resolved. Thus, the potential savings to the dischargers are not included in these cost estimates.

Potential for Wastewater Reuse. Wastewater reuse will almost certainly become a key element of the dischargers' nutrient strategies. Reuse programs could significantly reduce nutrient loads by diverting a portion of the effluent – and its nutrient loads – away from the surface water discharge. It is often not cost-effective in the Piedmont because of marginal soil conditions, topography, and other factors.

Some opportunities for irrigation exist, but reuse has generally not been found to be cost-effective in much of the North Carolina piedmont. The soils tend to have limited hydraulic capacity, and the amount of land required to avoid overloading those soils surpasses the need. Suitable application sites tend to be scattered, increasing the complexity and cost of the distribution system. Wastewater reclamation for residential, commercial, or industrial use is less land-dependent than irrigation, but the dischargers have no such programs in place at this time, and it is difficult to know if enough opportunity exists to help the dischargers meet their proposed nutrient limits.

Reuse should become a much more attractive option when compared with the high cost of the advanced treatment alternative. Reuse alone is not sufficient to replace advanced treatment option: if BNR processes reduce nitrogen to 2 mg/L, the dischargers would have to reuse up to half of their effluent (at full permitted flow) to meet their final limits. Still, it may help reduce or delay the need for the more expensive treatment units.

Figure 4.3
Sensitivity of Costs to Assumed Parameter Values



At present, approximately 115 reuse systems are authorized in North Carolina, with a total permitted flow of 59 MGD. Reclaimed wastewater is typically used for irrigation, industrial needs (cooling or process waters), indoor demands (such as toilet flushing), fire protection (separate from potable water systems), or aesthetic purposes (fountains, ponds, etc.). Costs vary widely depending on size of the system, the nature of the end uses and their locations, and other factors. However, a few examples will serve to illustrate a range of costs and demonstrate that the range is well below the cost of MF-RO systems.

- Orange Water and Sewer Authority (OWASA). Projected 0.66 MGD in 2010, approximately 2 MGD in 2028, primarily for cooling tower makeup and irrigation waters for UNC-CH campus. Flows represent 9% and 15% of potable water supply, respectively. Reduced demand for potable water deferred water treatment plant (WTP) expansion by about 15 years, resulting in more than $3 million savings over next nine years (NPV). Will potentially defer construction of new Jordan Lake WTP, pump stations, and transmission lines, for a savings greater than $50 million (NPV).

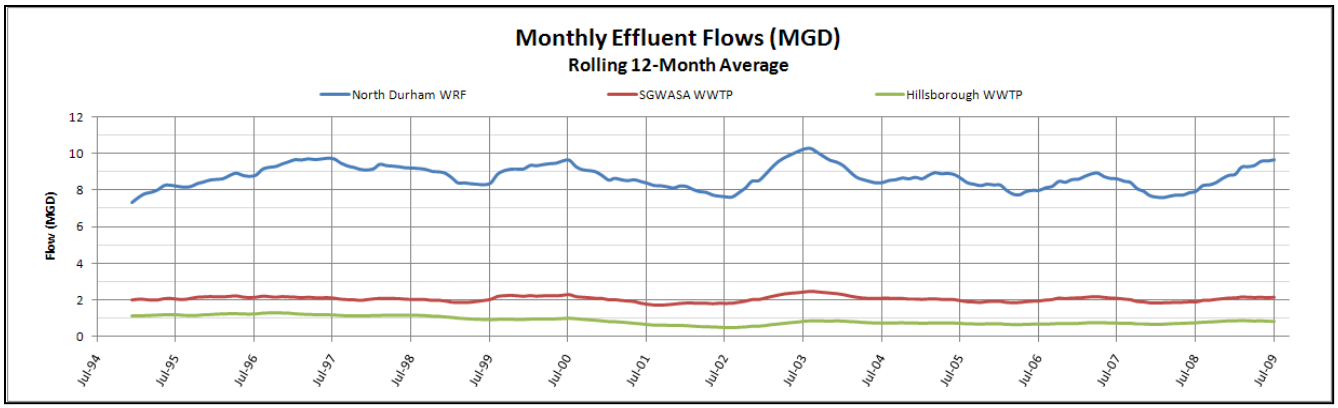
- City of Wilson. Three users, permitted for 4.1 MGD reuse, current use is 0.43 MGD. Capital cost of the system was $7.7 million.
- City of Lexington. Two users, permitted for 0.309 MGD, current use is 10 MG/year (about 30,000 gallons per day on average). Cost was $1.5 million for treatment upgrades, O&M costs are $28,000/yr.
- City of Raleigh. Permitted for less than 5 MGD, capital cost of about $22 million.

The Division has proposed new rules governing the voluntary generation and use of reclaimed wastewater (T15A NCAC 02U, Reclaimed Water). The rules' fiscal note considers the cost of new distribution lines for the irrigation of food crops with reclaimed water. It estimates that 15 different generators of reclaimed water, each with up to 3 miles of distribution lines, would pay a total of $3.7 million dollars for those lines (about $100,000/mile).

The Division believes that the Stage 2 nutrient limits (and, to some extent, the Stage 1 mass limits) will fundamentally shift the 'economic landscape' for wastewater management in the Upper Falls watershed and that the potential high costs of advanced treatment will drive the dischargers to re-consider the feasibility of wastewater reclamation and reuse. Any attempt to guess the nature and extent of their reuse efforts at this time would be purely speculative and without any real basis. Therefore, the cost estimate provided here represents the worst-case cost of meeting the proposed nutrient limits.

Effect of Rate of Flow Increases on Stringency of Mass Limits. The advanced treatment improvements become necessary as wastewater flows rise over time and the equivalent concentrations for nitrogen and/or phosphorus fall below the levels attainable by conventional technology alone. A slower rate of growth would delay the need for those upgrades and for major expenditures by the dischargers. Figure 4.4 shows that the average annual flows for the three facilities increased slowly, if at all, from 1995 through 2008. If growth remains flat, the assumed implementation schedule and costs could prove to be conservatively high.

Figure 4.4
Historical Flows at Upper Falls Treatment Facilities



Need for Stage 1 Limits, Lower Falls Watershed. It is likely that Stage 1 reductions in the Upper watershed will be sufficient to improve water quality in the Lower reservoir; hence, the limits for the Lower Falls dischargers may not be essential to achieving the Falls strategy's water quality objectives. Still, the proposed rule does set limits for the Lower Falls dischargers in order to ensure that nutrient loads do not increase above 2006 baseline levels, to provide a degree of equity among the Upper and Lower dischargers, and to respond to concerns about potential nutrient impacts at Raleigh's water intake in the Lower reservoir.

New Dischargers. The proposed rule specifies that a new or expanding discharger must acquire the necessary nutrient allocations for its discharge, not to exceed the equivalents of 3.0 mg/L TN and 0.2

mg/L TP. The restriction on the allocations was meant to require use of best available technology prior to discharge but was drafted before the Stage 2 limits were developed. Because the limits are more stringent, it has little impact on the discharger as written and should be reconsidered before final adoption of the rule.

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Chapter 5: Agriculture

Step 1: Basic Information

1.1 Rule Reference No.	.0264
1.2 Analyst	John Huisman, Senior Environmental Specialist
1.3 Office	NC Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27604
1.4 Your Phone	(919) 733-5083 ext 356
1.5 Comments on Agency Contact	Kelly Ibrahim NC Division of Soil and Water Conservation Agriculture Cost Share Program Information (919) 715-9630
1.6 Title of the Proposed Rule	Falls Lake Supply Nutrient Strategy: Agriculture
1.7 Citation	15A NCAC 2B .0280
1.8 Brief Description of the Proposed Rule	This proposed rule would require all persons engaging in agricultural operations in the Falls Reservoir watershed to reduce their collective nutrient contributions to the reservoir using a staged approach. Stage I establishes reduction objectives of 20% TN and 40% TP to be collectively achieved by agriculture by 2021. Stage II calls for reduction objectives of 40% TN and 77% TP to be collectively achieved by agriculture by 2036. Stage II will also require the buffering of all cropland and buffers and exclusion on all pasture if agriculture does not achieve their Stage I objective by 2021. Annual reports to the EMC documenting progress towards achieving the nutrient reduction objectives are required.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint.

Watershed modeling estimates that nonpoint sources make up approximately one-half to two-thirds of nitrogen inputs to Falls Reservoir, and more than four-fifths of phosphorus inputs. Agriculture comprises an estimated one-third to one-half of nitrogen and phosphorus inputs to the lake respectively, the single largest nonpoint contributor. Addressing agricultural loads would be an essential component of a comprehensive nutrient strategy.

3.2 How does the Proposed Rule Change Behavior?

The agriculture rule requires collective reductions in nutrient loading from agricultural lands at the county level over twenty five years through a staged approach. Stage I of rule implementation and calls for all producers collectively to meet a 20% reduction in nitrogen and 40% reduction in phosphorus loading within ten years (2011-2021). Stage II of implementation calls for producers to collectively meet the overall strategy objective of a 40% reduction in nitrogen and 77% reduction in phosphorus within an additional fifteen years after Stage I (2021-2036). The rule imposes no specific requirements on individual producers for this time period. An initial assessment of progress since the 2006 baseline would be completed within 2 years of the effective date. Farmers would be required to register with local agricultural agency staff, offered the opportunity to participate on local committees, and depending on their level of farm stewardship may be asked by local agency staff to implement practices. If after ten years the Stage I reduction objectives have not been achieved as determined by an oversight committee, the EMC may impose uniform implementation of buffers and livestock exclusion on all cropland and pasture operations respectively.

The rule also requires that residual application, animal waste application and surface irrigation pursuant to permits issued under 15A NCAC 02T . 1100, 15A NCAC 02T . 130, and 15A NCAC 02T .0500 respectively, to Lands within the Falls watershed shall meet Realistic Yield Expectation based nitrogen application rates and shall apply phosphorus in accordance guidance established in the most recent version of the North Carolina Agricultural research Service's Technical Bulletin 323 in order to minimize the potential for nitrogen and phosphorus loading to surface waters. The land application requirements go into effect on a permit by permit basis upon each individual permit'

Table 5.1: Agriculture Rule Timeline

Activity	Assumed Date	Elapsed Time After Effective Date
Effective Date	**1/15/2011**	**--**
Farmer Registration	**1/15/2012**	**12 months**
Submit local nutrient reduction strategy	**7/15/2012**	**18 months**
Initial Assessment Report	**1/15/2013**	**24 months**
First Annual Progress Report to EMC	**1/15/2014**	**36 months**
EMC Determines in Stage I objectives have been met	**1/15/2021**	**10 years**
EMC Determines if Stage II objectives have been met	**1/15/2036**	**25 year**

Step 4: Identify Impact

4-A. Regulated Parties

Table 5.2 below provides a summary of costs to all affected parties broken out by costs to private, local government, state, and federal. In this case all private costs are assumed to be to be costs to small businesses.

Table 5.2: Costs to Affected Parties

Year	Private (Farmers)					Local Government	State	Federal	Total
	Planning	Capital	O&M	Opportunity	Total	Total	Total	Total	All Parties
2011	$0	$0	$0	$0	$0	$20k	$10K	$60k	$90k
2012	$0	$0	$0	$0	$0	$20k	$10K	$60k	$90k
2013	$0	$0	$0	$0	$0	$20k	$10K	$70k	$90k
2014	$0	$170 – 210k	10k	$4 – $5k	$190 – $220k	$330 – $430k	$80	$520 - $620k	$800 - $930k
2015	$0	$180 – $210k	$20 -$30k	$10k	$210 – $240k	$340 – $440k	$80	$530 - $630k	$.83 – $1.0m
2016	$0	$180 - $220k	$30 – $40k	$10 – $10k	$230 – $270k	$330 – $440k	$80	$510 - $610k	$.82 – $1.0m
2017	$0	$180 - $220k	$40 – $50k	$20 – $20k	$240 – $290k	$350k – $450k	$80	$520 - $620k	$.85 – $1.0m
2018	$0	$190 -$220k	$60 – $70k	$20 -$20k	$260 – $310k	$350 – $460k	$80	$530 - $630k	$.88 – $1.0m
2019	$0	$190 -$230k	$70 – $80k	$30 – $30k	$280 – $340k	$360 - $470	$80	$540 - $640k	$.91 – $1.1m
2020	$0	$190 - $230k	$80 -$100k	$30 – $30k	$300 – $360k	$370 – $470k	$80	$540 - $640kk	$.94 – $1.1m

Projections of costs for advance treatment technologies and for points 10 years and further into the future involve a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.

Stage I Inflated NPV	$0	$.81 – $1.0m	$180 – $220k	$70 -$80k	$1.1 – $1.2m	$1.5 – $2.0m	$370	$2.9m	$4.0 – $4.6m
Stage II Inflated NPV	$0	$470 – $560k	$630 -$740k	$310 – $360k	$1.4 – $1.7m	$1.9 – $2.5m	$420	$1.5m	$3.1 – $3.6m
Total Inflated NPV (I+II)	$0	$1.3 – $1.5m	$.80 – $1.0m	$400k	$2.5 - $2.9m	$3.4 – $4.5m	$790k	$4.4m	$7.1-$8.3m

Notes:
- Opportunity Costs for Privates = Land Opportunity
- Local Government Costs are staff opportunity Costs and Capital Costs to meet N Rate Residual Land Application Requirements
- State & Federal Costs are Costs Share Opportunity (ACSP) and (EQUIP) in addition to Staff opportunity Costs

This rule requires all persons engaging in commercial agricultural operations in the Falls Reservoir watershed to reduce their collective nutrient contributions to the reservoir using a staged approach.

RP.0 Party Description

Name of Party	Agricultural operators.
Description	All persons engaging in commercial agricultural operations in the Falls watershed, including those related to crops, horticulture, livestock, and poultry. The rule applies to livestock and poultry operations above certain specified size thresholds that capture the great majority of livestock operations.
General Baseline	Cropland in the Falls watershed is currently subject to the Neuse Agriculture Rule (15A NCAC 2B .0238) which requires a 30% reduction in nitrogen loading from Agriculture in the Neuse River Basin relative to the 1991-1995 baseline. The six counties located in the Falls Watershed (Durham, Franklin, Granville, Orange, Person, and Wake) are subject to the Neuse Agriculture Rule and are currently meeting or exceeding its reduction goals. The Division currently regulates confined livestock and poultry operations over certain size thresholds statewide, through both state and federal permitting. There are 6 cattle, 6 swine, and 1 poultry operations. The nutrient management practices required of operations under those existing permits and rules eliminates them as new implementation candidates. Grazing livestock agriculture does not currently face regulation in the watershed, other than that associated with the above-mentioned livestock permitting that includes waste application to crop fields. In terms of actions available to producers, all types of producers currently have voluntary technical assistance and cost-share programs available through both the NC Division of Soil and Water Conservation's (DSWC) (NC Agriculture Cost Share Program, or ACSP) and the USDA-Natural Resources Conservation Service, or NRCS (several programs). The contributions from these different cost-share programs are shown as opportunity cost under their respective categories (State) for the Ag Cost-Share Program and (Federal) for the EQUIP program. A discussion about the uncertainty related to available funds is included in the uncertainty section of this chapter. These programs have assisted individual farmers to implement nutrient-reducing BMPs to varying degrees in the watershed. In terms of actions taken by producers, implementation that occurred subsequent to the 2006 baseline would be credited toward collective rule compliance, and farmers may continue to use these assistance programs to help them meet the rule. The great majority of farms in the watershed have voluntarily implemented, either with or without cost share, the fundamental nutrient-reducing practice of maintaining or restoring riparian buffers along waterways (often these lands are too steeply sloped to make cropping practical under any circumstance). Most of these buffers were in place prior to the 2006 baseline and thus would not have achieved reductions relative to the baseline. This pre-existing presence of buffers on most waterways removes that as a BMP option to a large degree. Preliminary input from

	the agricultural community is that a second practice, nutrient management, has been implemented in significant quantities prior to 2006, reducing opportunities for further reductions. At least it appears that producers in good part substantially reduced nitrogen application rates fairly close to Cooperative Extension Service-recommended levels by 2006. We used this input to guide our projections of BMP implementation in this analysis. Costs related to meeting the requirements of the Nutrient Management rule also apply to farmers and state government entities overseeing agriculture. The costs for the Nutrient Management rule are included in Chapter 8.
Assumptions	The following overarching assumptions apply to our calculations for this rule: • We assume all agriculture operations in the Falls watershed meet the small businesses definition, therefore the costs to private parties represents the costs to small businesses. ▪ We assume rule compliance costs would be controlled by nitrogen requirements. While the rule requires specific reductions in phosphorus as well, the current available accounting criteria are qualitative in nature and would not allow for meaningful cost estimation. A discussion of the workgroups currently working on phosphorus crediting and accounting is provided in the uncertainty section of this chapter. ▪ We summed load reduction requirements across the watershed for both cropland and pastureland and estimated reduction needs for the entire watershed. ▪ State owned agricultural land in makes up less than 1% of all agricultural land in the watershed. Given its small size relative to privately owned farms and the fact that the use of the collective compliance approach utilized in this rule means there are not individual requirements, no capital costs were assigned to state owned agriculture lands. Ideally, proportional load reductions would be sought from both pastureland and cropland. However, due to the lack of opportunity for additional reductions from cropland above and beyond what they have already achieved under the existing Neuse Agriculture Rule, for the purpose of our cost evaluation we assume the full reduction objective to be met through nutrient reductions solely from pasture operations. ▪ We assume that the agricultural community would meet the Stage I nitrogen reduction objectives within 10 years (2021) and the Stage II objectives within an additional 15 years (2036). The agriculture community has strong support for the collective compliance approach and is very interested in avoiding individual requirements. They are already reporting a 20% reduction in loading from cropland which is captured as a credit in the low cost estimate scenario. Ultimately, the reduction needs are so great in Stage II that it is very likely that every opportunity for a reduction will need to be acted upon and costs of implementation would be unchanged regardless of a collective or individual approach. ▪ We also assume that all costs are evenly distributed over 25 years after effective date of the rule, and do not distribute any capital costs over 2011, 2012, or 2013, while in reality creditable implementation and associated costs are likely occurring during this intervening period, although it any BMPs implemented during this period could also be associated with continued implementation of

	the Neuse Agriculture rule and not represent a direct cost associated with the Falls Agriculture Rule. We do include planning costs during this time period. Nevertheless, not including capital costs in the first three years could cause some cost estimates to be slightly underestimated. This analysis calculates both total subsidized and unsubsidized costs to farmers. With the subsidized costs shown under the capital costs category under private parties in Table 5.2 reflecting 75% cost share payments that are available from state and federal programs. The unsubsidized capital costs are captured as opportunity costs under the State and Federal category and shown in detail in the cost calculation tables in the Appendix. ▪ Cost share would likely occur in substantial amounts; lowering costs to farmers we projected rates of cost share availability in subject counties by assuming they would be awarded State ACSP funds in amount similar to what they received in 2009. We assume that the remainder of cost-sharing funds would come from Federal sources such as EQUIP. These costs are captured under the State and Federal costs in Table 5.2. ▪ We assume the universe of agricultural operations, for the nutrient loading calculations; to consist of cropland, hay and pastured livestock operations, although we go on to assume that all the needed reductions will come from pasture. This does not account for the following operation types: o Confined animal operations. Under other state and federal regulations they are required to follow nutrient management plans and setback requirements from water bodies for waste application. We assume they would not implement additional practices in the first five years of this rule. This was the case under Neuse and Tar-Pamlico agriculture rules. o Horticultural operations. Nutrient loading from and controls on these operations were not addressed under Neuse and Tar-Pamlico agriculture rules, and an approach has not been defined for addressing them under this rule. Trends in the number and size of these operations in the watershed have not been defined, nor has nutrient loading from them. ▪ We assume constant pre-BMP TN loss rates from cropland and pastureland across each year. We use established literature nitrogen and phosphorus export rate values for the Albemarle-Pamlico Region. The soils in these two regions are similar enough to assume the export rate values apply to both areas. o Trends or shifts in individual crop acreages. Crop shifts affect TN fertilization rates, and could result in more or less TN loss. Crop shifts result from economic factors that are difficult to forecast and beyond the scope of this analysis. Crop shifts could cause ***higher or lower*** costs than estimated here.
Data Sources	We reference information sources at point throughout this text and provide citations in Appendix B. Our Primary data sources are:

RP.1 Annual Capital Costs/Savings (ACS/S)

(a) Cost Baseline	Please refer to the general baseline discussion under RP.0 above.
(b) Description	We established load reduction needs by estimating baseline loads for cropland and pastureland and applying the strategy percent reduction goals to those loads. The loading numbers shown in Table 5.2 below represent a scenario in which we assume there has been no reduction in nitrogen loading from cropland under the Neuse Agriculture Rule since 2006. This would provide a high end estimate of costs. The Low cost scenario loading numbers are provided in the Appendix.

Table 5.3: Agriculture Acres, Baseline Loads, and Load Reduction Targets

Land Type	2006 Acres	Baseline N Load (lb/yr)	Stage I N Load Reduction Needs Thru 2021 (lb/yr)	Total N Load Reduction Needs Thru 2036 (lb/yr)
Pasture	29,225	204,575	40,915	81,830
Cropland	55,459	720,967	144,193	288,387
Total	84,684	925,542	185,108	370,217

Since these reduction needs are relative to a 2006 baseline, we obtained cost share data on BMP implementation from 2001 through 2006, estimated associated load reductions, and deducted those from the above targets to set net additional reduction needs as an alternate cost scenario.

While cropland and pastureland are fertilized differently and require different management practices, we assume the total nutrient reduction would be achieved through reductions from pastureland practices due to the limited opportunity among row crops according to the NC DSWC.

In brief, our calculation method was this: we identified the main practice for achieving reductions from pasture; assigned the practice the total reduction target; estimated acres of the BMP needed based on per-acre loading rate reductions; and calculated costs associated with those acres using per-acre cost-shared and total cost values from NC ACSP.

We estimate both total cost of meeting the goals and the net cost to farmers assuming all implementation is cost-shared. It is important to note that the costs to farmers shown below assume full cost-share of practices. The capital costs to farmers equates to 25% of the total costs. The additional 75% of the costs are distributed to the State and Federal Government as opportunity costs under the Ag Cost Share Program and EQUIP respectively.

(c) Quantify $	Capital Costs to Producers (Farmers): (See Table 5.2) Stage I NPV: $810k – $1m Stage II NPV: $470k - $560k Stage I+II NPV: $1.3m – 1.5m

(d) Quantification Method	We first established load reduction needs based on baseline crop and pasture acres and their respective loading rates. Cropland acre numbers and pasture acre numbers were taken from the 2007 Neuse Annual Agriculture Report and the 2007 Ag Census, as detailed in the assumptions section below, which yielded the acres shown in Table 5.3 above. To obtain the baseline loads also shown in Table 5.3, we applied the following loading rates for cropland and pastureland to those acres: Cropland = 13 lb N/ac-yr Pastureland = 7 lb N/ac-yr We then estimated costs using the following steps, which are reflected in Table 3.4 and 3.5 below: 1. established a set of candidate BMPs, 2. apportioned the load reduction requirement among BMPs, 3. estimated and applied load reduction rates to each BMP to yield acres needed, 4. compared those acres to available acres, 5. deducted acres implemented 2007 to 20010 under ACSP to yield net acres needed, 6. Applied per-acre costs provided by the ACSP to yield total capital costs. Steps 1 and 2. During 2009 and 2010, we held meetings and discussions with representatives of the agricultural community in which we identified practices with the greatest potential for additional implementation. Based on feedback from the agriculture community, it was determined that almost if not all of the reduction would need to be achieved through the use of stream protection systems on pastureland. In our calculations, we assigned the total reduction need to this practice. Step 3. Estimating BMP Load Reduction Rates: **Pastureland** ▪ *Stream Protection System* would result in a reduction of .16 lb N/Linear Foot per year. This system involves fenced livestock exclusion from streams, a restored riparian buffer within the fenced area, alternate water source and hardened stream crossing. We obtained the reduction rate by applying 50% load reduction efficiency to a pasture loading rate of 7 lb N/ac-yr, and converting the resulting 3.5 lb N/ac-yr to lb N/LF of stream-yr to obtain .16 lb N/LF-year. We drew this logic from pasture accounting developed under the Tar-Pamlico agriculture rule. It was developed by a stakeholder team including NCSU pasture researchers, approved by the Tar-Pamlico Basin Oversight Committee, and endorsed by the NC Soil and Water Conservation Commission. For excluded buffers it recognizes two means of loading reduction - removal of direct deposition of waste in the stream and interception and treatment of water draining through the buffer. Our calculation retains the 7 lb N/ac-yr untreated pasture loading rate developed by the Tar-Pamlico point system, but updates the calculation by using the revised NLEW buffer efficiency[4] for an excluded 20' buffer described under the riparian buffer BMP above. We assumed a 20' riparian buffer. Based on

information provided by DSWC, 20' is the minimum amount of buffer used for such practices since that is the minimum amount recognized by Nitrogen Loss Evaluation Worksheet (NLEW) accounting and assumes producers would want to minimize losses of productive grazing land near streams.

We translated pasture acres to linear feet of stream using a stream density factor of 2.27 miles of stream per square mile of land area. This factor is specific to the Piedmont region of the Neuse River basin.

Step 4, Comparison to Available Acres. For riparian buffer and stream protection system BMPs, we translated total crop or pasture acres to linear feet of stream, and potential buffer, using the same 2.27 stream density factor described under the stream protection system above.

Step 5, Deducting Acres Implemented 2007 through January 2010. The NC DSWC provided acres of cost shared BMPs for this period from their database. This value does not reflect implementation that has occurred with cost share from USDA programs, which was not readily available. Such data would be incorporated into actual compliance accounting during implementation, so its absence from this calculation would result in a conservative ***overestimate*** of costs to producers.

Step 6, Equating Acres Needed to Costs. The NC DSWC provided average per-unit-of-BMP cost-shared capital costs for installation. These costs were inflated in our costs calculations using the Consumer Price Index Inflation factor. This value is 75% of full installation cost. We converted them to full installation cost to get full capital cost of rule implementation. We then took one-quarter of the full cost to get cost to producers, under the assumption that all practices would be cost-shared. We show both of these resulting costs for achieving the reduction goals in Tables 5.3

Table 5.4: Agriculture: BMPs Needed to Achieve Nutrient Reduction Objectives

Pastureland						
BMP Units	**% of Total Reduction**	**Load Reduc (lb N/yr)**	**Reduc Rate (lb N/ Unit-Yr)**	**United Needed (LF)**	**Per-Unit BMP Cap Cost ($/Unit)**	
Stream Protection System (LF)*	100%	312,539 – 370,217	0.16	962,252 – 1,139,830	$4.67	
Stream Protection System Load Reduction Rate			**Equivalents to Stream Density Ratio of 2.27 mi / mi2 Land**			
Pasture Loading Rate (lb/ac-yr)	7		Drainage Area (Ac) / LF Stream			0.0464
System Reduction Efficiency (%)	50%		Drainage Area (ft2) / LF Stream			2021
Load Reduction Rate (lb/ac-yr)	3.5					
Load Reduction Rate (lb/lf stream-yr)	0.16					
Pasture Export			**ACSP Cost Share Rate**			
Pasture Runoff Rate (lb/ac-yr)	4.8		Stream Protection System (75% of Costs)			$3.50
Cattle Direct Deposit Rate (lb/ac-yr)	2.2		Stream Protection System (Full Cost)			**$4.67**
Pasture Total Export Rate (lb/ac-yr)	7					

*** The lower end of the range a 20% credit for reductions on cropland achieved 2007-2010.**

(e) Assumptions	▪ We distinguish cropland from pastureland for two reasons – differences in fertilization and different nutrient-reducing management practices. Pasture is generally fertilized at much lower rates, so loading and reduction estimates differ from cropland. Pasture includes livestock-grazing lands, but also includes hay land. Livestock BMPs center on reducing their direct and indirect impacts to streams, clearly differing from cropland BMPs. ▪ We assume all reductions will be achieved through the use of stream protection systems on pastureland operations given the lack of opportunity for additional reductions from cropland. ▪ We developed two different load reduction needs and associated costs. The loading and reduction needs shown in Table 5.3 above represent a scenario in which we assume there has been no reduction in nitrogen loading from cropland under the Neuse Agriculture Rule since 2006. This would provide a high end estimate of costs. The Low cost scenario loading numbers are provided in the Appendix. The low estimate provided in the Appendix assumes that cropland agriculture has already achieved a 20% reduction in nitrogen loading from the 2006 baseline based on the 2007 Neuse Ag Annual Report to the EMC. This was used as a low end estimate given the inherent uncertainty of NPS accounting of the accounting tool used for developing the Ag. It is likely that Agriculture has in fact achieved reductions since the 2006 baseline, this the load reduction needs will fall somewhere between the high and low range used for estimating costs in this report. ▪ Three available land cover sources differed significantly in their estimates of cropland and pastureland acres. The source used by DWQ in its watershed model was USGS National Land Cover Database, while a second source was NC 2007 Ag Census, and yet a third was the 2007 Neuse Agriculture Annual Progress Report to the EMC. Evaluation of each suggested that the Neuse Ag Report to the EMC best represented proportions and acreage of crop and pasture lands for our purposes. Thus, we assume the acres reported in the 2007 Neuse Agriculture Report to the EMC is the most appropriate for these calculations for agricultural lands in the watershed. ▪ We assume no reduction in acres under agricultural control over implementation. The Falls watershed is an urbanizing watershed and while an agriculture land reduction trend exists statewide and likely in this watershed, how that trend weighs into compliance accounting under this rule has not been defined. By assuming no reduction benefit from land loss, we err in favor of ***overestimating*** annual costs. ▪ We assume that there will not be an increase in animal operations in the future. The animal industry favors locations within close proximity to meat processing plants to reduce production costs. There are no processing plants or plans to build processing plants in the Falls Lake watershed. ▪ We assumed established loading rate values and established BMP efficiencies provide a reasonable approximation of the compliance accounting method that would actually be used, (NLEW), during implementation when fuller data is developed. ▪ We assumed compliance would be achieved at a constant annual rate over the 25-year implementation period given that Stage I objectives represented one half of the overall objectives to be achieved by the end of Stage II, and inferred annual costs accordingly. ▪ We assumed that all practices implemented to meet the goals would be cost-share supported at the ACSP rate of 75%. Thus, we report final capital costs to producers that equal one-quarter of full capital costs for meeting the goals.

(f) Data Sources	Personal Communication: Dr. Deanna Osmond, NCSU Soil Science Dept, NC Cooperative Extension Service. [4]NLEW Committee Meeting Summary, January 4, 2007, Dr. Deanna L. Osmond, NCSU Soil Science Dept, Raleigh, NC. Gannon, Richard, 1997. *Effectiveness of Wetland and Riparian Areas for Treatment of Agricultural Pollution Sources: A Literature Review* (unpublished). Tar-Pamlico Pasture Point System, 2003. http://www.enr.state.nc.us/DSWC/pages/tar-pamlicoBMP.html. Bruton JG. 2004. *Headwater catchments: estimating surface drainage extent across North Carolina and correlations between land use, near stream, and water quality indicators in the Piedmont physiographic region*. Doctoral Dissertation, North Carolina State University, Raleigh, NC. 92 p. Meeting Summaries for September 2009 and December 2009 Agricultural Subcommittee Workgroup, Falls Lake Stakeholder Process. NC Division of Water Quality, Planning Section, Nonpoint Source Unit.

RP.2 Annual Operating Costs/Savings (AOC/S)

(a) Cost Baseline	Please see the general baseline discussion under RP.0 above.
(b) Description	DSWC staff has estimated this cost at 15% of installation costs, distributed over the BMP's lifespan as represented by the cost share contract period. O&M costs then are cumulative, increasing annually with the addition of each new increment of BMPs. Calculations are provided in Appendix E..
(c) Quantify $	Operating (O&M) Costs to Producers (Farmers): (See Table 5.2) Stage I NPV: $180k - $220k Stage II NPV: $630k - $740k Stage I+II NPV: $800k – 1.0m
(d) Quantification Method	Again we performed separate, parallel estimates for pasture only. While a contract period of 10 years was assumed for each BMP, the life and effectiveness of the BMP and its ability to be recognized as a reduction credit remain as long as the BMP is maintained. To calculate the annual operation and maintenance costs we developed an annual O&M cost of 1.5% of installation costs by assuming a 10-year distribution of maintenance costs, adding to 15% of installation cost over those 10 years. **Agriculture: Annual *Pastureland* O&M Costs to Farmers** **(See Appendix F)**
(e) Assumptions	▪ Maintenance would be15% of installation cost, distributed over the life of the BMP, as recommended by DSWC cost share staff. Since many BMPs continue to function beyond contract life, the annual fraction of installation cost would be proportionally less than estimated here, making this estimate a conservative ***overestimate***.
(f) Data Sources	NC Division of Soil and Water Conservation, in consultation with local Soil and Water Conservation Districts in the Falls watershed.

RP.3 Annual Planning Costs/Savings (APC/S)

(a) Cost Baseline	Please see the general baseline discussion under RP.0 above.
(b) Description	Farmers would rely on technical assistance provided by ACSP or USDA programs, and would absorb their own planning time (captured under their O&M costs) into their operations, but would not pay for planning services.
(c) Quantify $	$0
(d) Quantification Method	See Assumptions
(e) Assumptions	• We assume that the majority of technical assistance comes from the watershed technicians which are funded both through local government funds and Federal Funds through and the EPA 319 grant. The local government funds to pay for the technician positions are reflected under the planning cost category for Local Government, while the federal 319 grant is captured as an opportunity cost to the Federal government. • We assume the technical assistance and planning costs funded through local and federal government funding is an opportunity cost to state and federal government. • We assume that the minimal amount of planning time invested by farmers is captured under the 15% O&M cost to farmers.
(f) Data Sources	319 Grant Application and DSWC

RP.4 Regulatory Transaction Costs/Savings (RTC/S)

(a) Cost Baseline	Please see the general baseline discussion under RP.0 above.
(b) Description	Based on experience in the Neuse and Tar-Pamlico basins, we estimate that farmers would not incur any explicit regulatory transaction costs. Any participation in rule development would not require business costs. Local agricultural agency staff would incur the great majority of new transaction costs associated with implementing the rule. For this, a Clean Water Act Section 319 grant was obtained from NC Division of Water Quality for two new Soil and Water Conservation District Technician positions to carry out this work. In addition, an existing Division of Soil and Water Conservation staff position has been given the added responsibility of coordinating the agricultural elements of the Falls nutrient strategy. No new resources are provided for that responsibility. The costs for carrying out this responsibility by existing staff are captured as an opportunity cost to the State and Federal government.
(c) Quantify $	$0
(d) Quantification Method	N/A

(e) Assumptions	• N/A
(f) Data Sources	DSWC and DWQ staff

RP.5 Opportunity Costs/Savings (OpC/S)

(a) Cost Baseline	Please see the general baseline discussion under RP.0 above.
(b) Description	There would be opportunity costs to private parties associated with taking land out of production for buffers or cropland conversion BMPs. We used a uniform soil rental rate provided by DSWC staff of $43.00/ac-yr to estimate the foregone income from lost land use. This cost is then cumulative over the years of lost use, increasing annually with the addition of each new increment of BMPs. Total opportunity costs are shown in Table 5.2 above.
(c) Quantify $	See Table 5.2 Opportunity Cost to Private Parties (Farmers) Stage I NPV: $70k Stage II NPV: $310 - $360k Stage I+II NPV: $400k The following opportunity costs reflect the funding that would come from state and federal BMP subsidy programs and State staff time for implementing the rule. See Appendix E for a breakdown of Opportunity Costs to State & Federal Government. Regulatory / Opportunity Cost to State Government Stage I NPV: $370k Stage II NPV: $420k Stage I+II NPV: $790k Regulatory / Opportunity Cost to Federal Government Stage I NPV: $2.1 - $3.6m Stage II NPV: $1.0- $1.3m Stage I+II NPV: $3.1-$3.8

(d) Quantification Method	For opportunity costs to farmer, we applied the soil rental rate of $43.00/ac-yr provided by DSWC to the number of BMP acres added each year. To calculate opportunity costs to the state and federal governments we estimated the amount of staff time that would be required to implement the rules based on experience implementing similar rules in the Neuse and Tar-Pam, then multiplied the % of time per position by the annual salary of that position to come up with the annual opportunity cost incurred. We also calculated the State and Federal opportunity costs to represent the 75% or remaining share of funds needed to implement BMPs beyond the 25% cost incurred by farmers. As with the other cost estimates in the chapter the annual costs were inflated using the CPI index and discounted to estimate the net present value. See Appendix E.
(e) Assumptions	• The average soil rental rate estimate is a reasonable estimate of opportunity cost across the watershed. • Assumed Soil Rental Rate of $43.00/ac/yr based on information provided by DSWC • We assumed regulatory costs consisted of staff time and state and federal funds to support BMP implementation represented in the form of regulatory opportunity costs. The staff opportunity cost estimated in this chapter captures time needed to participate in the Basin Oversight Committee, work on outreach efforts to encourage BMP implementation and reviewing annual reports. • We DWQ staff time and the portion of the two technician's salary supported via the 319 grant represent an opportunity cost to implement the rules. This time and opportunity cost is in addition to the Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality) in the New Development Chapter for estimated state opportunity cost for implementing all rules. • We assumed an average Ag Cost Share Program (ACSP) funding allotment per county of $61,584 based on the average county award in 2009. The annual allotment was inflated and discounted. • We assumed the total ACSP funds per county would be spent on meeting the Falls Lake requirements • We assumed the remaining cost share funds needed each year would come from Federal Funding via EQUIP. • We assumed annual salaries and % of annual work times associated with implementing the rules with each staff member based on experience with implementing the Neuse and Tar-Pam Ag Rules (See Appendix E). • We assumed the participation of various state agency staff in Local Advisory Committee (LAC) and Watershed Oversight Committee (WOC) meetings represented an opportunity cost.
(f) Data Sources	NC Division of Soil and Water Conservation, in consultation with local Soil and Water Conservation Districts in the Falls watershed.

RP.0 Party Description

Name of Party	Local Governments
Description	The Agriculture rule calls for non-dedicated residual application, animal waste application and surface irrigation pesuant to permits issued under 15A NCAC 02T . 1100, 15A NCAC 02T . 130, and 15A NCAC 02T .0500 respectively, to Lands within the Falls watershed shall meet Realistic Yield Expectation based nitrogen application rates and shall apply phosphorus in accordance guidance established in the most recent version of the North Carolina Agricultural research Service's Technical Bulletin 323 in order to minimize the potential for nitrogen and phosphorus loading to surface waters. The land application requirements go into effect on a permit by permit basis upon each individual permit renewal.
General Baseline	The Division currently regulates land application of wastewater residuals through permits issued under 15A NCAC 02T . 1100, 15A NCAC 02T . 130, and 15A NCAC 02T .0500. Existing permits do not include nitrogen and phosphorus application requirements.
Assumptions	The following overarching assumptions apply to our calculations for this rule: • We assume the universe of land application operations includes lands authorized for land application under permits issued to Hillsborough, Durham, and OWASA for land application sites they maintain within the Falls Watershed
Data Sources	Personal communication with John Greene and Pat Davis of Orange County Water & Sewer Authority (OWASA).

RP.1 Annual Capital Costs/Savings (ACS/S)

(a) Cost Baseline	Please refer to the general baseline discussion under RP.0 above.
(b) Description	**Table 5.3: Permitted Land Application Fields in Falls Watershed**
(c) Quantify $	Increased Capital Costs Local Governments: (See Appendix F.) Stage I NPV: $1.4 - $1.9 million Stage II NPV: $1.8 - $2.4 million Stage I + II NPV: $3.3 - $4.3 million

Permit Holder	2009 # Fields	2009 Acres
Hillsborough	32	377
OWASA	27	388
Durham	78	1,012

(d) Quantification Method	We determined the number of permitted acres and assumed a uniform volume of application per acre per year. To estimate the total volume of residuals applied each year and converted that volume to a mass. We calculated the increase in disposal costs based on input from OWASA staff using a multiplier of 30% (low-end estimate) and 40% (high-end estimate) using an assumed current costs of disposal ($350/dry ton) We then multiplied the annual volume of residual disposed by the estimated increase in costs of approximately $105 (low) and $140 (high) per dry ton and adjusted for inflation. See Table E.6 in Appendix E for Calculation
(e) Assumptions	• Assumed the current costs of disposing of a dry ton of residuals was uniform across all facilities at $350 per dry ton. This cost may vary from facility to facility and errs on the high side and may result in an overestimation of costs. • All permitted acres receive the same volume of residuals per year: 15,000 gallons. Not all acres received application as some are in reserve and acres may receive less than the assumed amount. Therefore this assumption may tend to overestimate the volume of residuals applied and resulting in an overestimation in costs. • High end estimate based off 40% increase in disposal costs • Low end estimate based on 30% increase in disposal costs • We assumed no increase in volume since our high level approach is already likely overestimating the total volume and does not account for residuals that are not land applied but rather disposed of at composting facilities and therefore not subject to this rule. • We assume there is enough agriculture land to meet the land application need and that alternative methods of disposal would not be required. • We assume all costs increases are capital costs increases as a result of increased equipment use and overhead related to longer travel distances that would be needed to spread. • Assumed nitrogen application limits would be the limiting factor because a quantitative accounting tool for phosphorus loss from municipal land application sites is not yet available to inform cost estimates.

RP.2 Annual Operating Costs/Savings (AOC/S)

(a) Cost Baseline	Please refer to the general baseline discussion under RP.0 above.
(b) Description	There are no operation and maintenance costs associated with this requirement.
(c) Quantify $	$0
(d) Quantification Method	N/A

(e) Assumptions	N/A

RP.3 Annual Planning Costs/Savings (APC/S)

(a) Cost Baseline	Please refer to the general baseline discussion under RP.0 above.
(b) Description	There are no planning costs associated with this requirement.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A

RP.4 Regulatory Transaction Costs/Savings (RTC/S)

(a) Cost Baseline	Please refer to the general baseline discussion under RP.0 above.
(b) Description	There are no regulatory transaction costs associated with this requirement.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A

RP.5 Opportunity Costs/Savings (OpC/S)

(a) Cost Baseline	Please refer to the general baseline discussion under RP.0 above.
(b) Description	There are no opportunity costs associated with this requirement.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A

4-B. Implementing Agencies

IA.0 Party Description

Name of Party	The Nonpoint Source Program in the Planning Section of DWQ would have primary responsibility for administering and enforcing the proposed rule. Existing staff would assimilate this responsibility. Existing DWQ Regional Office staff in the Raleigh may carry out compliance and enforcement actions as needed. The Division of Soil and Water Conservation would have key responsibility for coordinating the agricultural elements of the Falls nutrient strategy. This includes collection and analysis of data, overseeing local District staff, interfacing with the agricultural community, and coordinating and reviewing annual reports. An existing staff position with DSWC has been given this additional responsibility. No new resources are provided. Local agricultural agency staff would incur the majority of new costs associated with implementing the rule. For this, a Clean Water Act Section 319 grant was obtained from NC Division of Water Quality under its FY2006 funding cycle that would provide for two new Soil and Water Conservation District Technician positions to carry out this work for the two counties almost entirely within the watershed and the other 4 counties partially within it.
Description	DWQ currently administers multiple water quality related programs including stormwater and wetlands permitting programs. DWQ works closely with several sister agencies on matters concerning water quality, agriculture, forestry, sediment and erosion control, and soil conservation.
General Baseline	The Falls Watershed is currently subject to the Neuse Agriculture Rule the implementation and compliance monitoring of agricultural strategies in the Falls Watershed would build upon this already existing DWQ program...
Assumptions	See this in section RP.0 in this chapter.
Data Sources	See this in section RP.1 in this chapter.

IA.1 Regulatory Development Costs/Savings (RDC/S)

(a) Cost Baseline	Currently, DWQ does not have regulatory development costs associated with agricultural strategies. A onetime opportunity costs has been estimated based on staff time devoted to developing the rule language.
(b) Description	The rule-making costs involve staff time to research and review the specific components of the rules, develop into the rule language, research cost/fiscal impacts, participate in meetings with stakeholders, plan and participate in public workshops/meetings/hearings, present information to Commission and Department, and file/process rule, forms, etc.
(c) Quantify $	See Section IA.1 Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality) in the New Development Chapter for estimated state opportunity cost for implementing all rules.
(d) Quantification Method	This cost represents an opportunity cost for DENR. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.

(e) Assumptions	See Section IA.1 Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality) in the New Development Chapter for estimated state opportunity cost for implementing all rules...
(f) Data Sources	See this in section RP.1 in this chapter.

IA.2 Monitoring & Recordkeeping Costs/Savings (MRC/S)

(a) Cost Baseline	Currently, DWQ, DSWC and the River Basin Technicians incur opportunity costs associated with and recordkeeping associated with areas agricultural strategies.
(b) Description	Monitoring and recordkeeping activities would be integrated with existing programs to the maximum extent possible. Any costs would be opportunity costs for DWQ to implement the rule component. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff. Activities would include coordination with sister agencies and local governments administering existing programs relevant to agricultural strategies.
(c) Quantify $	River Basin Technician Costs are captured under Federal and Local Government Costs in Table 5.2. A breakout of these costs is provided in Appendix E.
(d) Quantification Method	This cost represents an opportunity cost for DWQ, DSWC, and the River basin Technician. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(e) Assumptions	See Appendix E
(f) Data Sources	See this in section RP.1 in this chapter.

IA.3 Permitting Costs and Savings (PC/S)

(a) Cost Baseline	N/A
(b) Description	There are no permitting costs associated with this proposed rule.
(c) Quantify $	N/A
(d) Quantification Method	N/A
(e) Assumptions	See this in section RP.0 in this chapter.
(f) Data Sources	See this in section RP.1 in this chapter.

IA.4 Inspection and Enforcement Costs/Savings (IEC/S)

(a) Cost Baseline	N/A
(b) Description	Inspection for compliance with the proposed rule would be integrated with existing on-site compliance efforts.

(c) Quantify $	See Section IA.1 Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality) in the New Development Chapter for estimated state opportunity cost for implementing all rules.
(d) Quantification Method	This proposed cost represents an opportunity cost for DWQ to implement the rule component. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(e) Assumptions	See this in section RP.0 in this chapter.
(f) Data Sources	See this in section RP.1 in this chapter.

Step 5: Uncertainty and Alternatives

The cost estimates calculated for implementation of this rule were developed using the most recent research and best available data and accounting tools. However numerous assumptions and estimates are necessary to project long range costs of implementation. The long-term nature of this rule and the rapidly evolving field of agriculture best management practices combine to make projection of costs more than a few years into the future increasingly speculative. The costs as estimated in this chapter represent conservative high range estimates based on current available information, accounting tools and technology.

Agriculture nonpoint source pollution contribution and treatment involves a large degree of uncertainty and the research related to both nutrient loading and BMP efficiency is constantly evolving and being refined. Ultimately, the largest uncertainty comes from the limitations of current accounting tools. Currently, the best available method, the Nitrogen Loss Evaluation Worksheet (NLEW) represents end of management unit nitrogen loss and does not represent instream loading estimates. In the future, with the aid of additional research it may be possible to refine agriculture loading estimates and predicted reduction needs.

There are currently three workgroups, including the ACSP Pasture Group, the Jordan Lake Pasture Workgroup, and the Conservation Effects workgroup actively exploring additional Agriculture Pasture BMPS. They will also consider how accounting tools can be developed to track reductions from existing and future practices. Some of these additional pasture BMPS being considered include heavy use area modification, and alternating feeding locations. In addition to these activities, the NC Horse Council has submitted a 319 grant application seeking fund to aid in research to investigate BMP practices that would serve to achieve nutrient reductions from horse operations.

For the purpose of this fiscal analysis, the reductions are assumed to be achieved entirely through stream protection systems on pasture. However, it is likely that these rules and the large load reductions needed will drive innovation in technology and techniques resulting in more cost-effective means of achieving the necessary reductions. The number of agriculture BMPs available has grown extensively during the 25 year existence of the Ag Cost Share BMP program and the future may reveal additional effective practices not considered in this analysis.

Agriculture, while identified as a major contributor in the Watershed Model is the one source that is likely to passively decrease over time given the Falls Lake watershed is an urbanizing watershed and the number of Ag acres is likely to decrease over time. While the number of Ag acres in production in any given year is difficult to estimate a Neuse Ag statistical survey that is currently underway will help better define that number in the future. Regardless, it is clear the number of agriculture acres in the watershed has declined in recent years and will likely continue to do so. As this trend continues the absolute costs for achieving nutrient reductions from the agriculture sector will decrease as well.

An overarching uncertainty within the estimated costs of implementing the Agricultural Rule relate to how opportunity costs to private, state, and federal entities were appropriated. For the purpose of these cost estimates the funds provided through the state ACSP and federal EQUIP programs were assumed as opportunity costs to the state and federal government. However, it can be argued that these funds may instead represent an opportunity cost to private individual farmers both within and outside the Falls watershed. This is due to the fact that funds used to meet the Falls lake nutrient reduction requirements could theoretically have been used for other practices either located within the same county but outside of the Falls watershed or for non-nutrient related farm practices all together. Given the unique nature of how cost share money is awarded and administered on a county basis and the fact that breaking down opportunity costs among the various affected parties would be extremely complicated and involve a great deal of uncertainty we assume ACSP and EQUIP funding to be state and federal opportunity costs for the purpose of estimating the implementation costs of this rule.

Chapter: 6 Stormwater Requirements for State and Federal Entities

Step 1: Basic Information

1.1 Rule Reference No.	.0281
1.2 Analyst	John Huisman, Senior Environmental Specialist
1.3 Office (Your Organizational Location)	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 807 -6436
1.5 Comments on Agency Contact	Data for DOT calculations provided by Andy McDaniel, Hydraulics Unit, NCDOT, (919) 250-4100
1.6 Title of the Proposed Rule	Falls Water Supply Nutrient Strategy: Stormwater Requirements for State and Federal Entities
1.7 Citation	15A NCAC 2B .0281
1.8 Brief Description of the Proposed Rule	Provisions of the new and existing development stormwater rules, .0277 and .0278, are applied to state and federal entities, primarily the NC Department of Transportation (DOT), the National Guard Training Site, Department of Correction Facilities, and Hospital and School Campuses. The Division would function as implementing agency. These parties would be required to achieve nutrient loading reductions in stormwater runoff from existing developed lands under their control toward the strategy percentage goals. They would also be required to obtain permits from the Division for new development, demonstrating that stormwater discharges from development projects would achieve export rate targets equating to the strategy percentage goals. The DOT would also initiate a program to conduct nutrient management education of its staff and contractors who apply fertilizer on highway right of ways.
1.8 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint.

Watershed modeling estimates that nonpoint sources make up approximately three quarters of both nitrogen and phosphorus inputs to Falls Reservoir. Developed land uses comprise at least 12% of nonpoint inputs to the lake.

3.2 How does the Proposed Rule Change Behavior?

We separate our discussion throughout this chapter into **DOT, State Land** other than DOT, and **Federal Land**. The following table gives the make-up of state and federal landholdings in the watershed:

Table 6.1: State and Federal Stormwater: State/Federal Acreage in Falls Watershed

Entity	Acres	% of All Developed Land
DOT	**11,473**	**21.1%**
Developed State Land	**2,008**	**3.7%**
Developed Federal Land	**770**	1.4%
- "Other" Federal	4,279	N/A

- DOT Area provided by NCDOT, Hydraulics Unit.
- National Guard and Other acreages obtained in GIS data layers provided by DWQ

Based on the information in Table 6.1, we chose to include estimated costs for "Other" federal lands –. This category captures the 4,279 acres of undeveloped land that is part of the Camp Butner National Guard Facility. While this land is owned by the state it is under the control of the Federal Government. Only a fraction of the land is developed (770 acres) as reflected in table 6.1 above. The vast majority of the facility lands is undeveloped open space and training grounds which do not factor into our calculation here. Much of the remaining state and federal land in the watershed is comprised of state parks and other passive recreational cultural or historic sites, all of which we would expect to load nutrients at very low levels or related to agriculture research which would be covered under the agriculture rule. Thus we assumed that these lands represent an insignificant portion of nutrient loads to the watershed and therefore do not calculate loads for these lands.

This rule would require all State and Federal Entities in the Falls Reservoir watershed to install structural and potentially non-structural stormwater treatment practices on new development projects and existing developed areas. For new development, they would obtain permits from the Division project-by-project, demonstrating that stormwater runoff meets export rate targets equating to the strategy percentage goals. Stormwater designs would also reduce peak flow rates to protect receiving waters. For existing development they would obtain approval from the Division for and implement programs involving load-reducing activities on existing developed

lands at a meaningful annual rate toward the strategy goals. The DOT would also conduct nutrient management education/training of its staff and contractors who apply fertilizer.

DOT Baseline: DOT holds a Phase I NPDES Stormwater permit. The permit does *not* require water quality treatment on new development projects, thus costs associated with the new development requirements of this rule would be new. For existing development, the NPDES permit requires illicit discharge removal and nutrient management education/training programs, and it commits DOT to 'retrofitting' a total of 70 stormwater practices onto its developed lands statewide over the 5-year permit duration that began April 2005. The next five year permit is under review and will be going out for public comment later this summer. The anticipated approval date is August 2010. However, the permit states that retrofits should not be used for compliance with other Division stormwater regulations. Thus for these calculations, we do not recognize reduction credit based on DOT implementing some portion of its statewide retrofit requirements in the Falls watershed.

Baseline for other State & Federal Lands

There are several state owned hospitals, correctional facilities, cultural centers, and the federally operated Camp Butner National Guard Training Ground located in the Falls Watershed. As of 2010 none of these facilities hold a Phase II NPDES Stormwater permit requiring post construction stormwater treatment for new development.

Table 6.2: DOT Stormwater Program Implementation Timeline

Activity	Assumed Date*	Elapsed Time After Effective Date
Effective Date	**January 15, 2011**	**0 Months**
NCDOT submits stormwater management plan & begins implementation	**July 15, 2013**	**30 Months**
DWQ Request EMC approval of plan	**July 15, 2013**	**36 Months**
EMC approval	**July 15, 2013**	**36 Months**
NCDOT implements stormwater mgt. plan	**July 15, 2013**	**36 months**
Entities submit annual reports to DWQ	**August**	**Annual Basis**

*** Based on effective date of January 15, 2011**

Table 6.3: Federal Non-DOT State Land Stormwater Program Implementation Timeline

Activity	Assumed Date*	Elapsed Time After Effective Date
Effective Date – DWQ begins permitting new development activities	**January 15, 2011**	**0 months**
Entities submit load reduction programs to DWQ & begin Implementation of load reducing measures	**January 15, 2014**	**36 months (Begin Implementation)**
DWQ Request EMC approval of load reduction programs	**March 15, 2015**	**20 Months after EMC approval of Model Program**
EMC approval	**March 15, 2015**	
Entities submit annual reports to DWQ	**August**	**Annual Basis**

Step 4: Identify Impacts

The table below provides a summary of costs to all affected parties broken out by costs to federal entities, Non-DOT state entities and NCDOT . The first ten years of costs are provided to illustrate the

compounding nature and annual routine and infrequent (every five years) operation and maintenance costs. Where two estimates are given, the first number represents a most likely value, while the second is a conservative estimate. Cost estimates for federal and Non-DOT state lands are based on applying percentages to the costs calculated in Chapter 2 and Chapter 3 which detail costs for the New Development and Existing Development Rule respectively.

Note:
The biggest uncertainty related to projected costs to state and federal agencies is related to the assumption of how the amount of existing and future development was estimated. As explained in the general baseline discussion, the reasoning we applied to project new development in Chapter 2 was based on population growth statistics and proportions of existing land uses. This approach does not transfer well to state and federal lands. This uncertainty is further compounded by the assumption we used to estimate the costs to state and federal entities by assuming proportional loading by these developed lands to that of all existing and new development based on their percentage of landholdings. Growth projections are subject to a range of economic and other influences operating at different scales. We suspect that the character of new development in the form of land consumption may vary substantially among the various state and federal lands and would likely occur at a much lower rate than private commercial development. Given their small overall fraction of land holdings, the likely varying nature of both existing and new development among them the cost estimates provided for federal and Non-DOT state lands likely represent an overestimation of actual costs.

Table 6.4 Summary of Existing & New Development Stormwater Costs to Affected Parties

Year	State					
	Planning	Capital	O&M	Reg. TC	Opportunity	Total
2011	$0	$0	$0	$0	$0	$0
2012	$40 - $80k	$200 – $400k	$0	$40 -$100k	$0	$270 - $540k
2013	$370 - $410k	$200 – $400k	$10k	$40 -$100k	$0	$610 -$890k
2014	$370 – $410k	$1.5 -$1.7m	$70k	$40 -$100k	$0	$2.0- $2.2m
2015	$370 - $410k	$1.5 -$1.7m	$80k	$40 -$110k	$0	$2.0 - $2.3m
2016	$380 - $420k	$1.5 – $1.7m	$80k	$40 - $110k	$0	$1.5 – $1.8m
2017	$380 - $420k	$1.5 – $1.7m	$80 - $90k	$40 - $120k	$0	$1.6 – $1.9m
2018	$380 - $420k	$1.5 – $1.7m	$90k	$50 - $120k	$0	$1.6 – $2.0m
2019	$380 – $430k	$1.5 -$1.7m	$90 - $100k	$50 -$120k	$0	$1.7 – $2.0m
2020	$380 - $430k	$1.5 – $1.7m	$100k	$50 - $130k	$0	$1.7 – $2.1m
Projections of costs for advance treatment technologies and for points 10 years and further into the future involve a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.						
Stage I NPV	$2. – 2.2m	$7.0 - $8.1m	$380 - $390k	$250 - $700k	$0	$9.6 -$11.4m
Stage II NPV	$4.5 - $4.7m	$16.3 – $17.7m	$160 - $170k	$280 -$800k	$0	$22.7 - $24.9m
Stage I+ II NPV	$6.5 – $7.0m	$23.3 – $25.7m	$2.0 – $2.1m	$0.5 – $1.5m	$0	$32.3 - $36.4m

Year	Federal					
	Planning	Capital	O&M	Reg. TC	Opportunity	Total
2011	$0k	$0k	$0k	$0k	$0	$0k
2012	$1k	$3 - $5k	$0k	$1k	$0	$4 - 8k
2013	$5 - $6k	$3 - $5k	$0k	$1k	$0	$9 - $13k
2014	$5 - $6k	$21 - $23k	$1k	$1k	$0	$28 - $32k
2015	$5 - $6k	$21 - $24k	$1k	$1 – $2k	$0	$28 - $32k
2016	$5 - $6k	$21 - $24k	$1k	$1 – $2k	$0	$22 - $26k
2017	$5 - $6k	$21 - $24k	$1 - 2k	$1 – $2k	$0	$22 -$ 27k
2018	$5 - $6k	$21 - $24k	$1k	$1 – $2k	$0	$23 - $28k
2019	$5 - $6k	$21 - $24k	$2k	$1 – $2k	$0	$24 - $28k
2020	$5 - $6k	$22 - $25k	$2k	$1 – $2k	$0	$24 - $30k
Projections of costs for advance treatment technologies and for points 10 years and further into the future involve a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.						
Stage I NPV	$30k	$100 - $114k	$6k	$4 - $10k	$0	$140 - $160k
Stage II NPV	$60 - $67k	$230 - $250k	$24k	$4 - $12k	$0	$320 - $350k
Stage I + II NPV	$90 -$99k	$330 - $360k	$30k	$7 - $22k	$0	$470 - $510k

Year	NCDOT					
	Planning	Capital	O&M	Reg. TC	Opportunity	Total
2011	$0	$0	$0	$0	$0	$0
2012	$0	$0	$0	$0	$0	$0
2013	$0	$0	$0	$0	$74 – $220k	$74 - $220k
2014	$0	$480 - $710k	$3 - $4k	$0	$76 - $230k	$560 - $940k
2015	$0	$620 - $910k	$7 - $9k	$0	$77 – $230k	$.70 - $1.1m
2016	$0	$380 - $920k	$21 – $26k	$0	79 - 240	$.48 – 1.2m
2017	$0	$390 - $930k	$25 – $31k	$0	81 - 240	$.49 – 1.2m
2018	$0	$390 - $940k	$58 – $95k	$0	82 - 250	$.53 – 1.3m
2019	$0	$400 - $950k	$62 – $101k	$0	83 - 250	$.54 – 1.4m
2020	$0	$400 - $960k	$67 – $108k	$0	85 - 250	$.56 – 1.3m
Projections of costs for advance treatment technologies and for points 10 years and further into the future involve a great deal of uncertainty. There is good reason to believe that costs will ultimately be less than the values projected below.						
Stage I NPV	$0	$2.0 – $2.9m	$140 - $210k	$0	$400k – $1.2m	$2.5 - $4.3m
Stage II NPV	$0	$2.1 – $3.1m	$700k – $1.2m	$0	$400k – $1.3m	$3.3 – $5.6m
Stage I + II NPV	$0	$4.1 – $6.0m	$800k – $1.4m	$0	$850k – $2.6m	$5.8 – $10.0m

4-A. Regulated Parties

RP.0 Party Description (State and Federal Entities)

Name of Party	State and Federal entities
Description	As detailed in Section 3.2 above, the entities we address in these calculations are NC DOT and the following State Owned Lands: ▪ Camp Butner National Guard Training Site ▪ John Umstead Hospital ▪ Various Department of Correction Facilities ▪ Various Cultural Resource Centers and Schools *NOTE – A Full List of All the State & Federal Properties included in this chapters calculations is included in Appendix F.*

General Baseline	Please see Section 3.2 above for a description of the parties, their acreages, regulations to which they are currently subject, and the net additional requirements imposed by this rule. We provide fairly detailed cost estimates for DOT in Appendix F, however for the other state and federal lands we offer simplified cost estimates for several reasons. The acreage held by the developed state and federal land, about 2,000 acres, equates to approximately 4% of existing developed lands, a relatively small proportion. Also, we would expect the National Guard Training Site, since about 5,000 acres is largely forested, to load nutrients at very low levels. The reasoning we applied to project new development in Chapter 2 – based on population growth statistics and proportions of existing land uses - does not transfer well to these types of facilities. The cost estimates provided for federal and Non-DOT state lands likely represent an overestimation of actual costs. We suspect that the character of new development in the form of land consumption may vary substantially among them. Given their small overall fraction of land holdings, the likely varying nature of both existing and new development among them, and time constraints on this analysis, we chose not to conduct a full evaluation of their loading. Instead we assumed proportional loading by these developed lands to that of all existing and new development based on their percentage of landholdings. This calculation did not include state parks and other passive recreational cultural or historic sites (Appendix F), all of which we would expect to load nutrients at very low levels or related to agriculture research which would be covered under the agriculture rule. We apply those percentages to the cost figures in Chapters 2 and 3 to estimate costs to the Non-DOT state lands and federal entities. We provide those cost figures in Table 6.4, but do not repeat them in subsequent sections. The existing development and new development stormwater requirements cost are combined for each affected party. A full breakout of the costs is provided in Appendix F. The remainder of this chapter focuses on DOT costs
Assumptions	As detailed in Section 3.2 above, we make the following general assumptions: • We assume that retrofit requirements in DOT's current NPDES stormwater permit would not be applicable toward reduction credit under this rule. • As described in the General Baseline above, to simplify cost estimates to state and federal lands, we assume proportional existing and new state and federal development loading to all existing and new development in the watershed. • We assume state and federal entities will not incur any capital costs related to the existing development requirements until 2014 in accordance to the implementation date requirements detailed in the rule.
Data Sources	• DOT acreage provided by NCDOT, Hydraulics Unit. • Other State & Federal acreages obtained from NC OneMap and GIS data layers from DWQ • NPDES Stormwater permitting status provided by DWQ Stormwater Unit.

RP.1 Annual Capital Costs/Savings (DOT)

(a) Cost Baseline	As described in Section 3.2 above, DOT is currently regulated under a Phase I NPDES Stormwater permit. The permit does not require treatment of new development runoff and the existing development retrofitting requirements may not be applied toward satisfying existing reduction needs of this rule, thus all retrofitting costs of this rule would be new costs.
(b) Description	All new development treatment costs would be new. DOT estimated the number of new development projects requiring treatment, the associated BMP needs, and applied per-BMP costs based on their experience to date complying with their NPDES permit. DOT estimated that they will have a total of three new development projects over the next five years. DOT was no able to project further out than five years due to planning limitations. The predicted new development projects are expected to be redevelopment projects of existing DOT facilities in the watershed. All costs to meet the existing development portion of the rule would be new costs. DOT staff developed a cost estimate based on installing six stormwater BMP retrofit projects per year starting in 2014, equating to a total of approximately 132 stormwater retrofit BMPs by 2036. Two cost estimates have been developed to provide and estimated range of costs based on information provided by DOT. The lower figure is based on an assumption of lower construction and maintenance costs over time as BMP implementation becomes more effective. In addition, the higher cost estimate assumes the creation and funding of three additional DOT positions while the lower cost estimate assumes only one additional staff position. It is also possible that existing staff will implement the program requirements. In that case the costs estimated for the creation of the single staff position are assumed to be equivalent to and represent the opportunity cost absorbed by existing DWQ and DOT staff. We estimate the annual load reduction target using an averaged roadway export rate applied to DOT acres in the watershed. These loading estimates are provided in Appendix F. DOT would implement their stormwater program within 36 months of the rule effective date and begin to incur costs in 2013. To meet the required reduction needs cost incurred include capital, planning, and operation and maintenance costs. The capital cost estimates in includes design, engineering and construction of structural BMPs. The total capital cost range for Stage I and Stage II of implementation are provided below.
(c) Quantify $	See Table 6.4 above
(d) Quantification Method	***New Development:*** DOT staff estimated costs using the following approach: ▪ New roads: Must comply with the existing buffer rules and don't represent any new costs. ▪ BMP construction costs: Assumed all non-roadway projects are going to be redevelopment of existing facilities. Assumed two BMPs per redevelopment project with an area-weighted cost and proportional maintenance cost. ▪ O&M costs: Multiplied per-BMP maintenance costs based on experience by

the projected numbers of BMPs, calculated cumulative cost values year-by-year with additional BMP implementation.

- Planning costs: The planning cost element is reflected in the cost of creating one to three additional NCDOT positions to administer the stormwater program. In the event that no additional positions are created the equivalent costs are assumed as opportunity cost for existing staff to implement the program.

Existing Development: DOT staff provided a cost estimate based on installing six stormwater BMP retrofit projects per year starting in 2014, equating to a total of approximately 132 stormwater retrofit BMPs by 2036.

Reduction Need: DOT calculated the mass load reduction need as follows:

Export Rate: The DOT contracted runoff characterization studies from its primary routes with Drs. Jy Wu and Craig Allan of UNC-Charlotte and applied average export rates derived from those studies to all DOT road acres in the watershed:

- TN 3.17 lb N/ac-yr
- TP 0.53 lb P/ac-yr

Those calculations yielded the following table of mass load reduction needs from baseline for existing DOT roads.

Table 10.7: State and Federal Stormwater: DOT Baseline Loads and Reduction Needs

Existing Right of Way (Acres)	11,473
TN	
Base TN Load (lb/yr)	36,371
TN Reduction Goal (%)	40%
TN Reduction Need (lb/yr)	14,548
TP	
Base TP Load (lb/yr)	6,081
TP Reduction Goal (%)	77%
TP Reduction Need (lb/yr)	4,682

Implementation Scenario, Six stormwater BMP retrofit per year: This scenario assumes that DOT would meet the minimum implementation requirements of the rule by implementing at least six stormwater BMP retrofits per year. DOT provided a high and low cost estimate. The lower cost estimate assumes lower construction and O&M costs as streamlining of costs may be expected through implementation over time. In addition, the higher cost estimate assumes the creation and funding of three additional DOT positions while the lower cost estimate assumes only one additional staff position. It is also possible that existing staff will implement the program requirements. In that case the costs estimated for the creation of the single staff position are assumed to be equivalent to and represent the opportunity cost absorbed by existing DWQ and DOT staff.

DOT calculated these costs as follows and as shown in Table 10.8:

- *BMP Input Loading Rate:* The DOT contracted runoff characterization studies from its primary routes with Drs. Jy Wu and Craig Allan of UNC-Charlotte. DOT applied average export rates derived from those studies to all DOT road

	acres in the watershed. (TN 3.2 lb N/ac-yr and TP 0.53 lb P/ac-yr) ▪ *Number of BMPs Required:* According to the rule requirements, DOT is required to implement a minimum of six stormwater BMP retrofits per year. DOT identified a suite of six BMPs that DOT would likely use and projected proportions of use based on cost-effectiveness, and estimated the number of each implemented to meet the six BMP annual requirement. ▪ *Costs:* We applied per-BMP construction, planning, and operation and maintenance costs provided by DOT to the numbers of BMPs needed to estimate total costs for each category. We assumed a 25-year compliance period (2036) and divided total costs by that number to yield annual costs. For Operation & Maintenance costs DOT calculated year one routine costs along with five year infrequent maintenance costs and compounded them by the same number of additional BMPs each year to arrive at total annual and cumulative O&M costs. ▪ *Land Costs:* BMPs projects to meet the requirements of the existing development rule would be constructed on land already owned by NCDOT. Similarly, the new development projects is projecting will all be redevelopment projects on land already developed by NCDOT. Given that no new land needs to be purchased, there is no actual land cost. Although there is an opportunity cost associated with the BMP footprint, NCDOT argues that the existing land to be used for BMPs does not have a next best use, so the opportunity cost of land was not possible to estimate.

(e) Assumptions	▪ We assumed that the export rates derived from Wu and Allan for primary routes reflect those from all DOT roads in the watershed. These rates are below those estimated using other methods such as the Tar-Pamlico Export Method described in the existing and new development chapters. This assumption results in lesser reduction needs and may ***underestimate*** costs. ▪ For existing development costs we assumed the set of BMPs and the proportions of BMPs implemented to meet the requirements either can vary either way and yield significant changes to costs in ***either direction.*** ▪ For new development costs we assumed that DOT would have three redevelopment projects on existing DOT facilities requiring 2 BMPs each over the next five years. DOT was unable to estimate the number of projects further out than five years. While it is not expected that there will be numerous new non-road projects in the watershed, the short planning horizon may result in an underestimate of costs. ▪ DOT provided per-BMP cost data for all BMPs. We assumed these estimates to be accurate. Streamlining of costs may occur through implementation. In that case, actual costs would be ***lower*** than these estimates. ▪ We assumed no trading gains on DOT's part. This would appear likely given the apparent relative cost-ineffectiveness of retrofitting roadway projects.
(f) Data Sources	Wu, J.S. and C.J. Allan, 2001. *Sampling and Testing of Stormwater Runoff from North Carolina Highways: Final Report*. UNC-Charlotte, Dept of Civil Engineering, Charlotte, NC, July 2001.

RP.2 Annual Operating Costs/Savings (State & Federal Stormwater: DOT)

(a) Cost Baseline	Please see the description in Section 3.2 above.
(b) Description	For Operation & Maintenance costs DOT calculated year one routine costs along with five year infrequent maintenance costs and compounded them by the same number of additional BMPs each year to arrive at total annual and cumulative O&M costs.
(c) Quantify $	See Table 6.4 above
(d) Quantification Method	See Capital Costs Section. O&M costs are based on DOT costs to date for retrofits under its NPDES Stormwater permit.
(e) Assumptions	See Capital Costs Section.
(f) Data Sources	See Capital Costs Section.

RP.3 Annual Planning Costs/Savings (State & Federal Stormwater: DOT)

(a) Cost Baseline	Please see Section 3.2 above.
(b) Description	The planning costs are assumed to be the opportunity costs of performing the additional workload. The cost estimate is based off the assumed cost of the creation of between one and three additional staff positions at DOT.

(c) Quantify $	Stage I Planning / Opportunity Costs : $400K – $1.2 million Stage II Planning / Opportunity Costs (NPV): $400K - $1.3 million
(d) Quantification Method	See Capital Costs Section.
(e) Assumptions	See Capital Costs Section. Note that the Planning costs are assumed to be all opportunity costs, and are presented in the Opportunity Costs column of Table 6.4 above.
(f) Data Sources	See Capital Costs Section.

RP.4 Regulatory Transaction Costs/Savings (State & Federal Stormwater: DOT)

(a) Cost Baseline	Please see Section 3.2 above.
(b) Description	We assumed that these costs would are captured in the planning cost estimates.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	Given there are no permit fees associated with the new development and existing development rule, we assumed transaction costs to be captured under the planning costs provided in RP.3.
(f) Data Sources	N/A

4-B. Implementing Agencies:

Name of Party	DWQ
Description	The set of activities required by this rule would be absorbed into the workloads of existing Division staff. Staff would administer the permitting process for new development activities on a project-by-project basis, and would conduct compliance monitoring and enforcement on permitted systems. Division staff would also review and approve proposed DOT and state and federal programs for existing development, as well as conducting compliance monitoring and enforcement. Compliance tasks would include contacts with state entities, BMP site inspections, and obtaining and reviewing annual reports.
General Baseline	N/A
Assumptions	The costs to the Division for implementing the new development and existing development stormwater requirements for state and federal entities including DOT are already captured under state costs for implementing the New Development and Existing Development Stormwater Rules in Chapters 2 and 3 respectively.
Data Sources	N/A

Step 5: Uncertainty and Alternatives

The cost estimates calculated for implementation of this rule were developed using the most recent research and best available data and accounting tools. However numerous assumptions and qualified estimates are necessary to project long range costs of implementation. These projections of costs for points ten years and further into the future involve a great deal of uncertainty and there is good reason to believe that costs associated with this rule

will ultimately be less than the costs projected Table 6.4. The following is a brief overview of the uncertainties involved with these calculations.

The biggest uncertainty related to projected costs to state and federal agencies is related to the assumption of how the amount of existing and future development was estimated. As explained in the general baseline discussion, the reasoning we applied to project new development in Chapter 2 was based on population growth statistics and proportions of existing land uses. This approach does not transfer well to state and federal lands. Growth projections are subject to a range of economic and other influences operating at different scales. We suspect that the character of new development in the form of land consumption may vary substantially among the various state and federal lands and would likely occur at a much lower rate than private commercial development. Given their small overall fraction of land holdings, the likely varying nature of both existing and new development among them the cost estimates provided for federal and Non-DOT state lands likely represent an overestimation of actual costs.

Other uncertainties related to estimating costs for meeting the requirements of this rule mirror those discussed in earlier chapters related to the implementation of the New Development and Existing Development Stormwater Rile. As mentioned in those previous chapters, we expect current knowledge and technical tools for nutrient load accounting as applied to the rule to improve over time. It is likely that further refinements will be made to the accounting tool at points in the future. Such refinements could have significant impact on the character of new development and its costs.

As in previous chapters, we used structural stormwater BMP retrofits as the basis for our estimates because at this point values for other measures would be difficult to develop and apply broadly without undue complexity. We expect more cost-effective measures than structural stormwater BMP retrofits to emerge even during the course of Stage I. Thus we expect costs at any point to be less than the estimates given here.

Another reason to expect that more cost-effective solutions will emerge is the promising range of currently emerging practices. A number of drivers, including the growing need for water conservation, the costs of conventional retrofit approaches under this rule, and the growing field of alternative options are expected to result in ultimate compliance costs significantly lower than these projections suggest.

Chapter 7: Fertilizer Management

Step 1: Basic Information

1.1 Rule Reference No.	.0283
1.2 Analyst	John Huisman, Environmental Senior Specialist
1.3 Office	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 807-6436
1.5 Comments on Agency Contact	None
1.6 Title of the Proposed Rule	Falls Water Supply Nutrient Strategy: Nutrient Management
1.7 Citation	15A NCAC 2B .0283
1.8 Brief Description of the Proposed Rule	Rule requires fertilizer applicators to either take one-time nutrient management training offered by Cooperative Extension Service or to obtain and properly implement a nutrient management plan approved by a certified technical specialist for all lands to which they apply fertilizer.
1.9 Rule Category	Regulation

Step 2: Screening Analysis

See Table 10 of the Executive Summary

Step 3: Define the Problem and the Regulation

3.1 Why is the Regulatory Proposal Needed?

The Executive Summary describes the need for the entire set of rules that comprise the nutrient strategy. The proposed strategy calls for the equitable distribution of reduction responsibilities across all sources, both point and nonpoint.

Watershed modeling estimates that nonpoint sources make up approximately one-half to two-thirds of nitrogen inputs to Falls Reservoir, and more than four-fifths of phosphorus inputs. People applying fertilizer is a primary means by which nutrients are added to the watershed. We believe opportunity exists for significant improvements to fertilizer management that would yield reductions in nutrient losses to surface waters. The proposed rule would improve application practices, decrease wasteful loss, and increase beneficial capture and use by crops and other vegetation.

3.2 How does the Proposed Rule Change Behavior?

This rule is largely and education rule and builds upon the existing Neuse Rule requirements. It would require fertilizer applicators in the Falls watershed to either attend nutrient management training or

complete and properly implement certified nutrient management plans for the lands to which they apply within five years of rule effective date.

The training option amounts to a one-time action by affected parties; there is no requirement for subsequent continuing education. The certified plan option involves obtaining the plan if not already done and properly implementing the plan if not already being done. Thus, the certified plan option may result in long-term behavior change of improved fertilizer management (we hope that the training option will also result in such a behavior change where appropriate, but none is mandated under this option). In terms of associated costs, according to the NC Cooperative Extension Service (Hardy et al, 2003) and others, improved nutrient management can be expected to yield cost savings to applicators as opposed to additional costs. Properly implemented nutrient management involves the following:

- Nutrient application based on the priority nutrient concept.
- Optimal timing and application methods.
- Applicators would calibrate and properly operate equipment.
- Nutrient quantities determined by realistic yield expectations (RYEs).
- Soil testing at least every one to three years (free) - Soil Test Analysis is currently provided free of charge by NCDA.

References:

Hardy, D.H., D.L. Osmond, and A. Wossink, 2003. SoilFacts: An Overview of Nutrient Management with Economic Considerations. Publication Number AG-565-01. North Carolina Cooperative Extension Service, January 2003. Available at http://www.soil.ncsu.edu/publications/Soilfacts/AG-565-01/SFnutmgt12-21-02.pdf.

Step 4: Identify Impact

4-A. Regulated Parties

RP.0 Party Description

Name of Party	Nutrient Applicators

Description	This rule applies primarily to the people who actually apply nutrients to the land, their direct supervisors, and consultants who provide nutrient management advice. These are the parties on whom our fiscal estimates are based. The exception to the above description is that the rule does not apply to residential landowners who apply nutrients to their own property, and commercial or industrial landowners who apply nutrients to their own property where such lands, under common management totals less than five acres. Owners and managers of lands where fertilizer is applied are also subject to the rule but can meet requirements simply by ensuring that applicators to their lands comply with one of the two options. The owners of these lands are responsible for ensuring their contracted applicators meet the requirements of this rule. The time needed to verify the contractor's compliance is negligible and therefore any associated costs would be minimal. We assume no cost to these parties and do not discuss them further. The cost to farmers to meet the requirements of the nutrient management rule are in addition to the costs to farmers to meet the requirements of the Agriculture rule discussed in Chapter 5. Land uses named in the rule are commercial cropland, greenhouses, golf courses, fertilized public and institutional lands, and fertilized commercial, industrial, and residential lands. We simplify the range of applicators to the following four categories for this analysis: ▪ waste applicators for confined animal operations, or CAFO's; ▪ cropland agriculture; ▪ pastureland agriculture; and ▪ turf, landscape, and nursery.

General Baseline	***CAFO's:*** All waste applicators for CAFO's of sufficient size to require non-discharge permits from the Division under the existing 15A NCAC 2T Rules would be in compliance with the rule by virtue of having a certified nutrient management plan. We estimate this to be virtually all confined animal operators with the exception of dry litter poultry applicators, who do not need certified plans and so would not comply automatically. ***Cropland and Pastureland Ag:*** Farmers in the Neuse River Basin are already subject to the Neuse Nutrient Management Rule (15A NCAN 02B .0239) which requires landowners, leasees and commercial applicators that are applying nutrients to 5 or more acres of residential, agricultural, commercial, recreational or industrial land as of the effective date of the rule, August 1, 1998, to either attend nutrient management training or to develop nutrient management plans for their lands within five years of the rule's effective date. Through a partnership between the NCSU Soil Science Department and North Carolina Cooperative Extension staff, seventeen nutrient management training sessions were held throughout the basin between 2000-2001, resulting in 1,850 applicators being trained. In December 2007 a follow-up training was promoted and conducted by NC Cooperative Extension staff in Wilson County. That supplemental offering trained an additional 24 applicators from both the Neuse and Tar-Pamlico Basins that had not been originally. Based on the extensive outreach efforts under the existing Neuse Rule, it is likely that the vast majority of applicators in the Neuse Basin, and therefore in the Falls watershed have already received this training and are in compliance with the rule requirements. This rule simply serves as a safe guard to capture any applicators who may have been missed during the earlier training sessions. Any applicators that have already taken the training under the Neuse Rule or have obtained a voluntary cost share contract for nutrient management from either the NC Division of Soil and Water Conservation or the USDA Natural Resources Conservation Service would be in compliance with the rule by virtue of having a certified nutrient management plan. ***Turf, Landscape, and Nursery:*** Same baseline as cropland and pasture applicators as described above.

Assumptions	▪ Overall, based on the Division's experience implementing rules in the Neuse and Tar-Pamlico River Basins we find that there would be minimal costs to affected parties to implement and comply with this rule. For the implementers, providing the training would displace other responsibilities of existing staff, while trainees would face lost wages for time spent taking training, as further described below. Given the availability of the minimal cost training option to applicators and based on past experience, we assume that only those who *already* meet the certified plan option will choose that alternative instead. As described in the baseline section above, some agricultural applicators do meet that option. However, we also discuss below the scenario of choosing the certified plan option without having a plan in place already. ▪ For those who choose the training option, we assume that this one-time, one-day requirement would result in the direct cost of one day's lost income. Local county offices of the NC Cooperative Extension Service would conduct trainings. They would charge no fee. In Neuse and Tar-Pamlico Basins, Extension obtained grant funding from DWQ to cover the minimal costs of training, and they will most likely make arrangements to do so for this rule as well. Attendees would travel minimal distance due to the small size of the watershed therefore we assume they would incur no significant travel costs. Attendees would incur a day's worth of opportunity costs associated with not carrying out normal job responsibilities. We calculate that direct cost. We also note that employers routinely incur costs associated with training employees as an accepted part of business. ▪ In the event that an applicator chooses the certified plan option and does not already meet its requirements, we assume there would still be no net cost. While there is up-front planning cost, agricultural evaluations show that applicators are likely to realize net *savings* by obtaining and properly implementing certified nutrient management plans[1] resulting in them spending less money on purchasing fertilizer they don't need as a result of following the management plan There would be no new capital, labor, or operation and maintenance costs beyond what applicators incur now associated with obtaining site information and applying fertilizer, even though O&M practices such as equipment calibration, application rates and timing may change as a result of rule compliance. In addition, both the NC Division of Soil and Water Conservation and USDA-NRCS provide cost share for this practice at the rate of $6/acre/yr for three years, further adding to the likelihood of net savings. This would not result in any increased costs to DENR. Any additional burden on the ACSP is captured under the Agriculture rule opportunity costs. ▪ As described in the baseline section above, and based on input from NCSU staff and extension[2] we assume the vast majority of applicators in the Falls watershed received nutrient management training under the Neuse Rules and would therefore already be compliant to the rule. ▪ We assume that there are less than 50 applicators in the Falls watershed that would need to take nutrient management training. Given the large number already trained under the Neuse Rules and the fact that most agriculture operation are concentrated in the lower Neuse Basin and not the Falls Watershed this may be an overestimation artificially inflating the estimated costs.

Data Sources	[1] Personal Communication: Dr. Deanna Osmond, NCSU Soil Science Dept, NC Cooperative Extension Service. [2] Hardy, D.H., D.L. Osmond, and A. Wossink, 2003. SoilFacts: An Overview of Nutrient Management with Economic Considerations. Publication Number AG-565-01. North Carolina Cooperative Extension Service, January 2003. http://www.soil.ncsu.edu/publications/Soilfacts/AG-565-01/SFnutmgt12-21-02.pdf.

RP.1 Annual Capital Costs/Savings

(a) Cost Baseline	Capital costs in fertilizer equipment and labor vary by applicator type.
(b) Description	As described in the assumptions section above, we anticipate no additional capital costs to any group associated with the proposed rule. The training option would involve no capital costs. Under the certified plan option, even for applicators who do not already meet the requirements of this option, they may calibrate or use their equipment differently in implementing a certified plan, but it would not require any new capital investments nor increased labor costs.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.2 Annual Operating Costs/Savings

(a) Cost Baseline	Existing operating costs for nutrient management vary by applicator type.
(b) Description	As described in the assumptions section above, we do not anticipate any new operating costs to any group resulting from compliance with this rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.3 Annual Planning Costs/Savings

(a) Cost Baseline	All applicators face planning costs under existing rules: ***CAFO's***: Animal waste applicators must complete training and receive certification from the Division, and subsequently keep waste application plans current. As described in the general assumptions section RP.0 above, they would meet certified plan requirements without additional action, so this rule would impose no new planning (or other) costs on them. ***Cropland and Pastureland:*** Farmers plan nutrient applications to varying degrees. The vast majority of applicators received training under the Neuse Rule or currently have a certified plan or likely contract with fertilizer dealers for turnkey planning and application services, or hire consultants to develop or revise plans, which the farmers then implement. These operators would take the training option at no cost. ***Turf, Landscape, and Nursery:*** Planning costs vary among these applicators. None have certified plans in place and all would take the training option at no cost.
(b) Description	See above.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	See the Baseline and Assumptions discussion in the General section RP.0 above.
(f) Data Sources	N/A

RP.4 Regulatory Transaction Costs/Savings

(a) Cost Baseline	Agricultural applicators who are required to have and maintain certified waste utilization plans have associated regulatory transaction costs
(b) Description	There would be no new permitting or compliance costs resulting from this rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

RP.5 Other Costs/Savings

(a) Cost Baseline	Producers routinely attend commodity meetings, take training and attend other educational events during the less demanding winter months.
(b) Description	Lost income associated with completing the training option: producers who attend the training would incur lost income for the one day required to travel and participate in the training. Trainings will be held during the winter when farm income is relatively low.
(c) Quantify $	$5,300 in 2011.

(d) Quantification Method	Since the great majority of trainees are expected to be farmers, and the total cost is very small, we used farm-based values for the entire calculation. We estimated the number of applicators who would take training and associated that with a single day's lost income. We estimated the number of applicators who would take training at less than 50. This is assumption is based on input from NCSU staff. This figure reflects an estimate of the number of applicators who did not take the training under the Neuse Rule and staff turnover and new applicators moving into the area. We estimated a daily crop farm income for winter months. Statewide average net crop farm incomes were available from NC Agricultural Statistics, along with percentage of net annual income by month: Estimated annual net crop farm income in 2011 = ~$51,000 or $196/day Feb-Mar income is 4.5% of annual versus 8.3% of annual for an average month, so winter income is 54% of average income: 54% ($196) = $106/day; $106 (50 farmers) = ~$5,300/day
(e) Assumptions	▪ Assumed that most trainees would be pasture farmers as in the Neuse and Tar-Pamlico. ▪ Assumed agricultural incomes are sufficiently close to non-agricultural to apply agricultural values to all trainees, given also the small total cost. ▪ Assumed inflated 1997-2001 wages are sufficiently close to anticipated 2011 wages.
(f) Data Sources	USDA-Economic Research Service. Economic Indicators of the Farm Sector. As provided by NC Department of Agriculture & Consumer Services, Agricultural Statistics Division at http://www.ncagr.com/stats/income/incmthyr.htm and as included in North Carolina Agricultural Statistics 2002, p.12.

4-B. Implementing Agencies

IA.0 Party Description

Name of Party	Division of Water Quality (DWQ)
Description	The Division of Water Quality (DWQ) would be responsible for implementing the proposed rule. Planning Section staff in the central office would likely coordinate implementation. The Division would rely on and coordinate with the NC Cooperative Extension Service to carry out the training component of the rule. Division Regional Office staff that includes field offices in Raleigh and Winston-Salem would conduct compliance as needed. Several other agencies administer programs that promote and fund sound nutrient management practices that play into implementation of this rule. Local coordination, education, planning assistance, and agronomic testing capability are provided by these programs. The programs would help implement the training or assist farmers to meet the certified plan option. The agencies include: ▪ Cooperative Extension Service – NCSU Soil Science and County Offices ▪ NC Division of Soil and Water Conservation (DSWC) ▪ USDA - Natural Resources Conservation Service (NRCS) ▪ NC Department of Agriculture - Soil Testing Laboratory (NCDA)
General Baseline	Current staffing levels would be sufficient to carry out rule implementation.
Assumptions	N/A
Data Sources	See Section IA.1 Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality) in the New Development Chapter for estimated state opportunity cost for implementing all rules.

IA.1 Regulatory Development Costs/Savings (Division of Water Quality)

(a) Cost Baseline	The Planning Section of the Division is responsible for developing and coordinating watershed restoration initiatives. Development of the Falls nutrient rules is within the scope of our work.

(b) Description	Rule development involves staff time to: research rule components; plan and coordinate the rulemaking process; develop and revise rule language; research and document fiscal impacts; conduct/participate in stakeholder meetings; plan and conduct public workshops/meetings/hearings; present information to the Commission and agencies; and file and process rules, forms, etc.
(c) Quantify $	This cost represents an opportunity cost for the Division. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(d) Quantification Method	See Section IA.1 Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality) in the New Development Chapter for estimated state opportunity cost for implementing all rules.
(e) Assumptions	Given that this rule parallels the already existing Neuse Rule the associated research to develop the rule and opportunity costs associated are nominal.
(f) Data Sources	N/A

IA.2 Monitoring & Recordkeeping Costs/Savings

(a) Cost Baseline	The Planning Section of the Division is responsible for developing and coordinating watershed restoration initiatives. Development of the Falls nutrient rules is within the scope of our work.
(b) Description	DWQ would be responsible for developing a database of applicators including those who complete the training option.
(c) Quantify $	This cost represents an opportunity cost for DWQ. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(d) Quantification Method	See Section IA.1 Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality) in the New Development Chapter for estimated state opportunity cost for implementing all rules.
(e) Assumptions	Given that this rule parallels the already existing Neuse Rule the opportunity costs associated with recordkeeping are nominal.
(f) Data Sources	N/A

IA.3 Permitting Costs and Savings

(a) Cost Baseline	N/A
(b) Description	There are no permitting costs associated with this proposed rule.
(c) Quantify $	$0
(d) Quantification Method	N/A
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.4 Inspection and Enforcement Costs/Savings

(a) Cost Baseline	N/A

(b) Description	Applicators that choose the certified plan option may be subject to compliance inspections and enforcement actions.
(c) Quantify $	Any staff time that may be required for enforcing nutrient management plans represents an opportunity cost for DENR. No new funds are being requested for implementation, but tasks would be integrated into existing job description and folded into workloads of existing staff.
(d) Quantification Method	See Section IA.1 Regulatory Development Costs/Savings (RDC/S) (Division of Water Quality) in the New Development Chapter for estimated state opportunity cost for implementing all rules.
(e) Assumptions	N/A
(f) Data Sources	N/A

IA.5 Other Costs/Savings: Program Implementation Costs

(a) Cost Baseline	Cooperative Extension staff at NCSU currently develop educational and training information and materials and county Extension staff currently carry out training as part of their job duties.
(b) Description	The proposed rule states that either DWQ or CES would issue the certification for nutrient management training. Based on implementation of this rule in the Neuse and Tar-Pamlico, Extension would conduct the training with support from DWQ. The minimal direct costs would likely be defrayed through Section 319 grant funds as done in the other basins. There would be opportunity costs to Extension staff in the form of displacing other activities to carry these out. We estimate those hours and salaries here.
(c) Quantify $	**Year 2011 - $2,350** Is a one time opportunity cost the training staff from NCSU extension 2011 for the time invested in giving two training sessions in 2011. Additional trainings are not presumed to be needed (see assumption below).
(d) Quantification Method	Proportional to Neuse and Tar-Pamlico experience, we estimate a total of 2 training sessions to serve all of the applicators with the six counties in the Falls Watershed. Trainers would attend a 1-day train-the-trainer session led by NCSU faculty, , would require one additional day total to prepare for conducting local trainings, and would spend 1 day performing the training. Altogether: 2 staff x 3 days x $60,000/yr salary, fringe, benefits / 260 work days/yr =~ $1,380 Add NCSU faculty time of preparing for the train-the-trainer session and giving the talk: 3 days total x $80,000 / 260 work days/yr = ~ $925. The costs incurred by farmers and the state to comply with this rule are relatively minor in comparison to other cost.

(e) Assumptions	Assumed all costs are incurred in 2011 We assumed two training sessions with 1 day for "training the trainer". Due to the small number of applicators who likely need training we do not assume any additional training would be needed in the future. In the event that additional trainings are needed every five years the costs would be nominal due to the low number of applicators who would likely require training.
(f) Data Sources	N/A

Table 7.1: One Time Cost Summary

Total Costs/Savings:	**Private Costs** **Nutrient Applicators**	**State Costs** **NCSU Trainers**
Capital	$0	$0
Operating	$0	$0
Planning	$0	$0
Regulatory Transaction	$0	$0
Opportunity	$5,300	$2,350

Notes:
All costs assumed to be one-time costs occurring in 2011.

Step 5: Uncertainty and Alternatives

Much of the Falls Watershed is pasture. Farmers typically do not apply fertilizer to these lands and the overall amount of crop land in the watershed continues to shrink each year so the need for nutrient management training is not as strong as it is in other more row crop intensive portion of the watershed. The costs captured in this chapter are based on lessons learned during implementation of similar rules in the Neuse and Tar-Pam.

DWQ plans to solicit additional comment on this rule during the public hearings to explore how the rule may be implemented in the most effective manner in the Falls watershed in light of comments raised by the agriculture industry that nutrient management plans should not be required because it could promote fertilizer application since most lands currently under apply. Should the overall approach for this rule change due to additional comments provided during the public comment period it is possible the implementation costs could increase. However, since this is largely and education rule the majority of costs are opportunity costs and are relatively minor compared to the magnitude of costs of the other rules that make up the Falls Lake nutrient management Strategy.

Chapter: 8 Proposed Rules without Implementation Costs

Step 1: Basic Information

The following three proposed rules (.0275, .0276, .0282) and two rule amendments (.0235, .0315) have no associated costs as they are administrative in nature, and any costs would be captured by the costs estimated for the other rules. A brief description of each rule is provided below.

1.1 Rule Reference Nos.	.0275 .0276 .0282 0235 .0315
1.2 Analyst	John Huisman, Senior Environmental Specialist
1.3 Office (Your Organizational Location)	Division of Water Quality Planning Section 1617 Mail Service Center Raleigh, NC 27699-1617
1.4 Your Phone	(919) 807 -6436
1.5 Comments on Agency Contact	John Huisman, Senior Environmental Specialist
1.6 Title of the Proposed Rule	.0275 Falls Water Supply Nutrient Strategy: Purpose & Scope .0276 Definitions .0282 Options for Offsetting Nutrient Loads .0235 Neuse River Basin Nutrient Sensitive Waters Management Strategy: Basinwide Stormwater Requirements .0315 Neuse River Basin
1.7 Citation	15A NCAC 2B .0275 15A NCAC 2B .0276 15A NCAC 2B .0282 15A NCAC 2B .0235 15A NCAC 2B .0315

1.8 Brief Description of the Proposed Rules	***Rule .0275, Purpose and Scope*** Describes strategy purpose, scope, and objectives; identifies the set of rules comprising the strategy; designates Falls watershed as a 'critical water supply watershed', which allows the EMC to require more stringent measures than minimum Water Supply Watershed requirements; defines geographically the "Upper Watershed" and "Lower Watershed"; identifies the baseline time period; establishes nitrogen and phosphorus (N and P) percentage reduction goals and corresponding point and nonpoint source lake loading targets relative to the baseline; establishes that all local governments – six counties and eight municipalities– are subject to certain rules; and provides for a two stage adaptive management approach. ***Rule .0276, Definitions*** Defines terms that apply across rules and are specific to the set of Falls rules. ***Rule .0282, Options for Offsetting Nutrient Loads*** Provides parties subject to the various rules - new development, existing development, State and Federal stormwater entities, agriculture, and point sources – the option to obtain more cost-effective reductions by purchasing reduction credit from other, offsite reduction sources or private sellers. Any opportunity costs associated with this rule are captured in costs calculated for .0277, 0278, and .0279. ***Rule .0235, Neuse New Development Stormwater Rule*** Clarifies that the Falls lake requirements supersede the Neuse stormwater rules for local governments located in the Falls Watershed. ***Rule .0315, Neuse River Basin (Schedule of Classifications)*** Formalizes reclassification of the non-Water Supply Watershed portions of the Falls watershed to WS-V and designates the entire watershed as Critical Water Supply Watershed.
1.8 Rule Category	Regulation

Appendices:

Falls Lake Nutrient Rules Fiscal Analysis

Appendices

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Appendix A: Rules Summary & Benefits

Appendix A: Falls Lake Rules and Benefits

Copies of the draft Falls Lake rules are available on the web at:

http://www.oah.state.nc.us/rules/proposedtemp/15ANCAC02BRules.doc

or

http://portal.ncdenr.gov.org/web/ps/nps/fallslake

or

http://fallslakestakeholder.wikispaces.com/Draft+Rules

Table A.1 - City of Raleigh Estimated Treatment Costs (Benefits of Costs Avoided)

Present Worth Costs (in 2010 Dollars) for the Four E.M. Johsnon WTP Expansion Options		
Expansion Options	**Net Present Value**	**Treatment - Minus Expansion Cost**
Option 1: Baseline Expansion to 100 mgd Capacity	$893,000,000	N/A
Option 2: Baseline Expansion + UV Facility	$936,000,000	$43,000,000
Option : Baseline Expansion + UV Facility + MIEX Facility	$1,131,000,000	$238,000,000
Option 2: Baseline Expansio + UV Facility + GAC Facility	$1,159,000,000	$266,000,000
	TREATMENT COST RANGE	**$43 - $266 million**
Notes:		
Expansion Options & NPV Costs from Tablee 6-7 on Pg. 6-8 of "Fiscal Note Support Doc" developed by Hazen & Sawyer - 12/09		
2010 Capital Costs		
Annual O&M for 30 years (2010-2039)		
Discount rate of 5%		
O&M of each future year was converted to 2010 dollars		
Baseline = Costs to expand from 75MGD to 100 MGD		

Table A.2 Benefit of Falls Lake - Capital Cost Component

Construction Costs	**Cost**
Kerr Lake Intake	$39,000,000
Kerr Lake Raw Water Pump Station	$69,500,000
Raw Water Transmission to E.M. Johnson WTP*	$267,000,000
Raw Water Booster Pump Station	$32,800,000
Neuse River WWTP Effluent Return Pump Station***	$28,800,000
Neuse River Effluent Return Transmission**	$222,700,000
Effluent Booster Pump Stations	$40,700,000
Subtotal (1)	$700,400,000
Capital Cost Allowance	
Engineering Studies, Design, and Construction Services (15% Subtotal 1)	$105,100,000
Subtotal (2)	$805,500,000
Legal Fees, Permits, and Approvals (5% Subtotal 1)	$35,000,000
Subtotal (3)	$840,500,000
Contingency (25% of Subtotal 3)	$210,100,000
Total Estimated Project Capital Costs	**$1,050,600,000**

Appendix B: New Development

Table B.1. Outline of Requirements for State-Mandated Stormwater Programs, Falls Watershed

Requirement (Based on Classification)	**WS-II BW**	**WS-III BW**	**WS-IV PA**	**Phase II**	**Neuse NSW**	**Proposed Falls NSW**
Permitting Authority	Local Gov't	Local Gov't	Local Gov't	Local Gov't	Local Gov't	Local Gov't
Low Density Max. BUA **(1)**	12%	24%	24%	24%	N/A	N/A
High Density Max BUA **(2)**	30%	50%	70%	None	N/A	N/A
Low Density Setback (2.5)	30'	30'	30'	30'	50' RB	50' RB
High Density Setback (2.5)	100'	100'	100'	30'	50' RB	50' RB
S/W Control Req. for High Density **(3)**	1" R/O	1" R/O	1" R/O	1" R/O	1" R/O	
TSS Removal Requirement	85%	85%	85%	85%	85%	
Stormwater Drawdown **(4)**	Note 4	Note 4	Note 4	Note 4	Note 4	
Flow Control Req.	No	No	No	1-yr 24-hr peak match	1-yr 24-hr peak match	1-yr 24-hr peak match
Vegetated Conveyances for Low Density **(5)**	Yes	Yes	Yes	Yes	N/A	N/A
Deed/Property Restrictions Required **(6)**	Yes	Yes	Yes	Yes	N/A	N/A
Cluster Dev. Allowed **(7)**	Yes	Yes	Yes	Yes	N/A	N/A
10/70 Provision Allowed **(8)**	Yes	Yes	Yes	No	N/A	N/A
NSW Load Limits **(10)**	No	No	No	No	3.6 lb N/ac/yr	2.2 lb N, .33 lb P /ac/yr

BUA – Built-Upon Area; **BW** – Balance of Watershed outside Critical Area; N – Nitrogen; **NSW** – Nutrient Sensitive Waters, P – Phosphorus; **PA** – Protected Area, **RB** – Riparian Buffer, **R/O** – Runoff, **S/W** – Stormwater; **TSS** – Total Suspended Solids, **WS** – Water Supply watershed,

Notes to Table B.1.

(1) Low-density limits are represented in the table in terms of maximum built upon area percentages. In addition, the following dwelling unit per acre limits may be used in lieu of these percentages:
- 6% BUA is equivalent to 1 dwelling unit per every two acres.
- 12% BUA is equivalent to 1 dwelling unit per acre.
- 24% BUA is equivalent to 2 dwelling units per acre.

(2) High-density limits are represented in maximum built upon area percentages only. No dwelling-unit-per-acre limits apply.

(2.5) For NSW watersheds, RB = 50', 2-zone riparian buffer. Zone 1 inner 30' undisturbed, Zone 2 outer 20' vegetated. Exceptions set out in Table of Uses, categorized as exempt, allowable, or allowable with mitigation.

(3) Stormwater Control Requirement: The '1" R/O' requirement as specified in the table corresponds to capturing the runoff from a 1-inch storm.

(4) Drawdown Requirement: Runoff volume drawdown time varies between programs but must be a minimum of 24-48 hours (depending on the program), but not more than 120 hours; may differ based on BMP selected.

(4.5) Flow Control: For Phase II, Neuse and Tar-Pamlico stormwater programs, there shall be no increase in peak flow leaving the site from the predevelopment conditions for the 1-year, 24-hour storm.

(5) The low-density option requires the use of vegetated conveyances to the maximum extent practicable and shall not have a discrete collection system.

(6) Where applicable, deed/property restrictions and protective covenants are required by the locally issued permit and incorporated by the development to ensure that that subsequent development activities maintain the development (or redevelopment) consistent with the approved plans. For the 20 Coastal Counties& Phase II Projects, this must be recorded prior to issuance of a certificate of occupancy.

(7) Cluster development is defined in 15A NCAC 02B .0202 (16) as the following: "the grouping of buildings in order to conserve land resources and provide for innovation in the design of the project including minimizing stormwater runoff impacts."

(8) The "10/70 Provision" is defined in 15A NCAC 02B .0214 , .0215, and .0216 . In general, it allows a local community to set aside 10% of each jurisdiction's portion of the watershed outside the critical area to be developed up to 70% BUA in the water supply watershed. In 1995, the 5/70 provision was changed to the 10/70 provision. This change was optional, and some local governments chose to retain the 5/70 provision.

(9) This provision allows projects to be classified as low density for built-upon areas up to 36%, provided that no curb and gutter is used.

(10) Neuse stormwater nutrient loading limits specified in 15A NCAC 2B .0235 apply in the rule-named local government jurisdictions within the Neuse River Basin.

Opportunity Costs of Falls Nutrient Rules to DWQ
- Falls Rulemaking Fiscal Analysis -

Overall Rules Development
(DWQ NPS Unit ESS) .5 FTE * 1 yr (July 2008 – June 2009) * $70k = $30k
.9 FTE * 2.5 yrs (July 2009 – Dec 2011) * $60k = $135K
(DWQ Administration) .25 FTE * 1 yr *100k = $25k
.6 FTE * 2.5 yrs * $100k = $150k
(Modeling Staff) 2 FTE * 1 yr * 70k = $140k
(NPDES and BPU Staff) .3 FTE * 3.5 yrs * $80k = $85k
(RRO Staff) 3 FTE * 6 mo * $70k = $105k
Total = $670k over 3.5 yrs, entered into fiscal note as 2011

Overall Rules Implementation
(DWQ NPS Unit ESS) .7 FTE * $70k = $49k for 5 yrs, then .3 FTE * $70k = $21k indef'ly
(DWQ Administration) .2 FTE * 100k = $20k/yr for 5 yrs, then .1 FTE * 100k = $10k indef.
(401, RRO, SPU, NPDES, BPU) .5 FTE * 70k = $35k/yr indefinitely
Total = $100k/yr for 5 yrs, then $66k indefinitely

New Development - Additional
DWQ - Model Ordinance Development: $0 (use Jordan)
DWQ – Accounting Method $0 (use Jordan)

All FTE estimates assume salary * 1.4 = total FTE cost based on budgeting experience for existing positions

Table B.2. Master Table of BMPs defined as used throughout New Development and Existing Development Cost

Notes
Stormwater Wetland: -Drainage Area[3]: 4.5 acres - Median of 9 studied wetlands, ranging from 0.5 to 10 acres. -Footprint[1]: 0.02 x DA x 1.15 (additional 15% for slope) -Installation Cost[1]: $3,852 x $DA^{0.484}$ -O&M costs[1]: ($4,502*$DA^{0.153}$)/20 years - Lifetime O&M cost distributed annually over 20 years
Bioretention: -Drainage Area[3] 0.9 acres - Median of 19 studied bioretention cells, ranging from .019 - 17 acres. -Footprint[1]: 0.025 x DA x 1.15 (additional 15% for slope) -Installation Cost[1]: [$10,162*$(DA)^{1.088}$ + $2,861*$(DA)^{0.435}$] / 2 (Average of clay and sandy soil costs) -O&M costs[1]: ($3,437*$DA^{.152}$)/20 years - Lifetime O&M cost distributed annually over 20 years
Wet Detention: -Drainage Area[3]: 8.0 acres - More conservative than 12.1 acre median of 10 studied wet detention ponds ranging from 0.37 - 20 acres -Footprint[1]: 0.015 x DA x 1.15 (additional 15% for slope) -Installation Cost[1]: $13,909*$(DA)^{0.672}$ -O&M costs[1]: ($9,202*$DA^{.269}$)/20 years - Lifetime O&M cost distributed annually over 20 years
Dry Detention : -Drainage Area[3]: No equation available, used wet detention drainage b/c most similar BMP. -Footprint[1]: No equation available, used wet detention equation b/c most similar BMP. -Installation Cost[1]: No equation available, used wet detention equation b/c most similar BMP. -O&M costs[1]: No equation available, used wet detention equation b/c most similar BMP.
Grassed Swales: -Drainage Area[2]: 1.0 acre assumed - Min. length of grassed swale is 100 feet per one drainage acre. -Footprint[2]: Min. bottom width 2 ft, 5 ft width chosen. 1 acre DA requires minimum 100 ft length. Therefore, 5'x100'*1 ac = 500ft^2 = .01 acres -Installation Cost[2]: $0.50/$ft^2$ = $0.50*5'*100' = $250 O&M costs : No equation available, used bioretention equation b/c most similar BMP.
Filter Strip Level Spreader: -Drainage Area: 2.5 acre chosen as a middle value -DA greater than 5 acres are difficult to manage. -Footprint[2]: 100 ft width (perpendicular to flow) and 50 ft length per one acre of drainage. 100'*50'*2.5 = 12,500ft^2 = 0.287 acres -Installation Cost[2]: $0.35/$ft^2$ for seed of $0.80/$ft^2$ for sod . Average is $0.58/$ft^2$. $0.58*100'x50x2.5 = $7,250 Liner (according to SET manual[4]) is $3-10/linear-foot. Average of $6.50 is used. $6.50*50'=$325 O&M costs : No equation available, used bioretention equation b/c most similar BMP.
Infiltration Devices: -Drainage Area[2]: 2.5 acre chosen as middle value - 5 acres is maximum DA. -Footprint[2]: 4' average depth. To treat 1" of rainfall, volume would need to be 2.5 ac x 1in / 12in/ft x 43,560ft^2/ac = 9,075ft^3 / 4' = 2,269 ft^2 (0.052 ac) -Installation Cost[2]: Infiltration basin = 13.2V^{0.69}$ - Infiltration trench = 33.7V^{0.63}$ - Use 9,075ft^3 volume and take the average of the two infiltration BMPs = $8,800 O&M costs : No equation available, used bioretention equation b/c most similar BMP.
-Buffer w/ Level Spreader: -Drainage Area[2]: 2.3 acre chosen as conservative value. 200' long and 50' wide buffer can treat up to 5 acres. -Footprint: Assumed footprint area is 0.2 of DA. -Installation Cost[2] - $600-$950 /ac = $775/ac O&M costs : No equation available, used bioretention equation b/c most similar BMP.
Sand Filter[1]: -Drainage Area[3]: 1.5 acres - Average of 9 studied wetlands, ranging from .5 to 9 acres. -Footprint[1]: 0.17*DA*1.15 (additional 15% for slope) (eqn. is for 100% impervious areas) -Cost[1]: $47,888 x $DA^{0.882}$ -O&M costs[1]: ($10,556*$DA^{.534}$)/20 years - Lifetime O&M cost distributed annually over 20 years

[1]Hunt & Wossink. An Evaluation of Cost and Benefits of Structural Best management Practices in North Carolina. 2003 (other equations for coastal plain, highly impervious and 100% impervious)
[2]July 2005 Draft BMP Manual
[3]Hunt & Moran. BMP Cost Estimate Study. Feb 2004.
[4]Upper Neuse Site Evaluation Tool (SET) Training. Tetra Tech
All BMP estimates are for New Development

Table B.3. Falls New Development Annual Acres

Step 1: **Project Pop Increase, Falls W'shed, 2000 - 2013**

2013 Pop As % of 2000 Pop

129%

Step 2: **Project Pop Increase 2013 - 2020 Falls W'shed**

Avg Annual % Growth, 2013 - 2020 (%)

Total 1.69%

2000 Land Cover From Falls Watershed Model

Cover Type	Upper 5 (Acres)	Lower (Acres)	Total (acres)
Developed, Open Space	26,185	13,312	39,497
Developed, Low	6,883	2,968	9,851
Developed, Medium Intensity	2,753	585	3,338
Developed, High Intensity	1,001	119	1,120
	36,822	16,984	53,806

Projected 2013 Landcover Based on Population Growth

Cover Type	Upper 5 (Acres)	Lower (Acres)	Total (acres)
Developed, Open Space	33,701	17,133	50,834
Developed, Low Intensity	8,859	3,820	12,679
Developed, Medium Intensity	3,543	753	4,296
Developed, High Intensity	1,288	153	1,441

2013 Consolidated Development Type Acreages (Ac)

	County Res	Muni Res	Comm/Ind
Upper 5	33,701	8,859	4,831
Lower	17,133	3,820	906
Total	50,834	12,679	5,737

2013 New D Acreage Increases (ac/yr)

	County Res	Muni Res	Comm/Ind
Upper 5	570	150	82
Lower	290	65	15
Total	860	215	97

Table B.4. Nitrogen BMP Cost Efficiency and Annual Cost for 2013

NITROGEN — **BMP Unit Capital Costs** — **Number of BMPs to Reduce 2013 Load** — **Ann O&M Costs, 2013** — **Developer Total Annual Costs, 2013**

County Residential

Loading = 2.8 lb/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)	BMP N Load Reduc Effic'y (%)	Per-BMP Annual N Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)	Per-BMP Annual O&M Cost ($/BMP-Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater Wetland	4.5	0.10	$7,977	$30,098	$3,115	$11,092	$1994	$3,500	40%	5	15%	19.8	99.8		$338	$6,701	$219,626	$39,486	$69,300
Bioretention	0.9	0.02	$5,590	$30,098	$736	$6,326	$1398	$3,500	35%	1	25%	33.0	27.5		$200	$6,608	$208,755	$46,121	$115,500
Wet Detention	8.0	0.14	$56,256	$30,098	$4,154	$60,410	$14,064	$3,500	25%	6	50%	66.0	369.6		$961	$63,453	$3,987,063	$928,232	$231,000
Extended Dry Det.	8.0	0.14	$56,256	$30,098	$4,154	$60,410	$14,064	$3,500	10%	2	2%	2.6	5.9		$961	$2,538	$159,483	$37,129	$9,240
Grassed Swale	10	0.01	$250	$30,098	$345	$595	$63	$3,500	20%	1	2%	2.6	1.5	516	$205	$542	$1572	$165	$9,240
Filter Strip/Level Spreader	2.5	0.29	$7,575	$30,098	$8,637	$16,212	$1894	$3,500	20%	1	2%	2.6	3.7		$236	$623	$42,800	$5,000	$9,240
Infiltration Devices	2.5	0.05	$8,800	$30,098	$1568	$10,368	$2,200	$3,500	30%	2	0%	0.0	0.0		$236	$0	$0	$0	$0
Buffer w/Level Spreader	2.3	0.46	$357	$30,098	$13,845	$14,202	$89	$3,500	30%	2	0%	0.0	0.0		$233	$0	$0	$0	$0
Sand Filter	15	0.03	$70,084	$30,098	$906	$70,990	$17,521	$3,500	35%	2	4%	5.3	8.0		$794	$4,191	$374,829	$92,511	$18,480
																$84,656			
									Enter # BMPs to match adj cell to load red need =>			132.0	515.9		$4,165	$4,994,127	$1,148,643	$462,000
																	$6,604,771		

Muni Residential

Loading = 5.03 lb/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)	BMP N Load Reduc Effic'y (%)	Per-BMP Annual N Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)	Per-BMP Annual O&M Cost ($/BMP-Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater Wetland	4.5	0.10	$7,977	$63,276	$6,549	$14,526	$1994	$3,500	40%	9	15%	6.5	58.4		$338	$2,183	$93,693	$12,863	$22,575
Bioretention	0.9	0.02	$5,590	$63,276	$1546	$7,137	$1398	$3,500	35%	1	25%	10.8	16.1		$200	$2,153	$76,719	$15,024	$37,625
Wet Detention	8.0	0.14	$56,256	$63,276	$8,732	$64,989	$14,064	$3,500	25%	10	50%	21.5	216.3		$961	$20,670	$1,397,254	$302,378	$75,250
Extended Dry Det.	8.0	0.14	$56,256	$63,276	$8,732	$64,989	$14,064	$3,500	10%	4	2%	0.9	3.5		$961	$827	$55,890	$12,095	$3,010
Grassed Swale	10	0.01	$250	$63,276	$726	$976	$63	$3,500	20%	1	2%	0.9	0.9	300	$205	$177	$840	$54	$3,010
Filter Strip/Level Spreader	2.5	0.29	$7,575	$63,276	$18,158	$25,733	$1894	$3,500	20%	3	2%	0.9	2.2		$236	$203	$22,130	$1629	$3,010
Infiltration Devices	2.5	0.05	$8,800	$63,276	$3,296	$12,096	$2,200	$3,500	30%	4	0%	0.0	0.0		$236	$0	$0	$0	$0
Buffer w/Level Spreader	2.3	0.46	$357	$63,276	$29,107	$29,463	$89	$3,500	30%	3	0%	0.0	0.0		$233	$0	$0	$0	$0
Sand Filter	15	0.03	$70,084	$63,276	$1905	$71989	$17,521	$3,500	35%	3	4%	1.7	4.7		$794	$1,365	$123,821	$30,136	$6,020
																$27,577	$1,770,348	$374,179	$150,500
									Enter # BMPs to match adj cell to load red need =>			43.0	3019					
																	$2,295,027		

Commercial/Industrial

Loading = 8.38 lb/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)	BMP N Load Reduc Effic'y (%)	Per-BMP Annual N Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)	Per-BMP Annual O&M Cost ($/BMP-Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater Wetland	4.5	0.10	$7,977	$230,029	$23,808	$31785	$1994	$3,500	40%	15	15%	18	27.2		$338	$609	$57,213	$3,590	$6,300
Bioretention	0.9	0.02	$5,590	$230,029	$5,621	$11,212	$1398	$3,500	35%	2	25%	3.0	7.5		$200	$601	$33,635	$4,193	$10,500
Wet Detention	8.0	0.14	$56,256	$230,029	$31,744	$88,000	$14,064	$3,500	25%	17	50%	6.0	100.6		$961	$5,768	$528,003	$84,385	$21,000
Extended Dry Det.	8.0	0.14	$56,256	$230,029	$31,744	$88,000	$14,064	$3,500	10%	7	2%	0.2	1.6		$961	$231	$21,120	$3,375	$840
Grassed Swale	10	0.01	$250	$230,029	$2,640	$2,890	$63	$3,500	20%	2	2%	0.2	0.4	136	$205	$49	$694	$15	$840
Filter Strip/Level Spreader	2.5	0.29	$7,575	$230,029	$66,009	$73,584	$1894	$3,500	20%	4	2%	0.2	1.0		$236	$57	$17,660	$455	$840
Infiltration Devices	2.5	0.05	$8,800	$230,029	$11,981	$20,781	$2,200	$3,500	30%	6	0%	0.0	0.0		$236	$0	$0	$0	$0
Buffer w/Level Spreader	2.3	0.46	$357	$230,029	$105,813	$106,170	$89	$3,500	30%	6	0%	0.0	0.0		$233	$0	$0	$0	$0
Sand Filter	15	0.03	$70,084	$230,029	$6,925	$77,010	$17,521	$3,500	35%	5	4%	0.5	2.2		$794	$381	$36,965	$8,410	$1,680
																$7,696	$695,290	$104,422	$42,000
									Enter # BMPs to match adj cell to load red need =>			12.0	140.4					

County	(<20%)	2.8
Muni	(20-49%)	5.03
Comm/Indus	(50-100%)	8.38

16.21

To change Loading Value, Click on "Tools", then "Scenarios", then chose the Scenario.

2013 Total # BMPs Needed

187.0

Grand Total 2013 O&M

$119,930

$841,712

Total 2013 Developer Costs

$7,459,765 $1,627,245 $654,500

Grand Total 2013 Developer Cost

$9,741,509

Table B.5. Phosphorus BMP Cost Efficiency and Annual Cost for 2013

PHOSPHORUS — **BMP Unit Capital Costs** — **Number of BMPs to Reduce 2013 Load** — **Costs, 2013** — **2013**

County Residental

Loading = .46 lb/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)	BMP P Load Reduc Effic'y (%)	Per-BMP Annual P Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)	Per-BMP Annual O&M Cost ($/BMP-Yr)	Per-BMP Annual O&M Cost ($/BMP-Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater Wetland	4.5	0.10	$7,977	$30,098	$3,115	$11,092	$1994	$3,500	40%	0.83	15%	18.0	14.9		$338	$338	$6,091	$199,660	$35,897	$63,000
Bioretention	0.9	0.02	$5,590	$30,098	$736	$6,326	$1398	$3,500	45%	0.18	25%	30.0	5.3		$200	$200	$6,007	$189,777	$41928	$105,000
Wet Detention	8.0	0.14	$56,256	$30,098	$4,154	$60,410	$14,064	$3,500	40%	1.47	50%	60.0	88.3		$961	$961	$57,685	$3,624,602	$843,847	$210,000
Extended Dry Det.	8.0	0.14	$56,256	$30,098	$4,154	$60,410	$14,064	$3,500	10%	0.37	2%	2.4	0.9		$961	$961	$2,307	$144,984	$33,754	$8,400
Grassed Swale	10	0.01	$250	$30,098	$345	$595	$63	$3,500	20%	0.09	2%	2.4	0.2	112	$205	$205	$493	$1429	$150	$8,400
Filter Strip/Level Spreader	2.5	0.29	$7,575	$30,098	$8,637	$16,212	$1894	$3,500	35%	0.40	2%	2.4	10		$236	$236	$566	$38,909	$4,545	$8,400
Infiltration Devices	2.5	0.05	$8,800	$30,098	$1568	$10,368	$2,200	$3,500	35%	0.40	0%	0.0	0.0		$236	$236	$0	$0	$0	$0
Buffer w/Level Spreader	2.3	0.46	$357	$30,098	$13,845	$14,202	$89	$3,500	35%	0.37	0%	0.0	0.0		$233	$233	$0	$0	$0	$0
Sand Filter	15	0.03	$70,084	$30,098	$906	$70,990	$17,521	$3,500	45%	0.32	4%	4.8	15		$794	$794	$3,810	$340,754	$84,101	$16,800
						$250,606	$53,287	$31500	Enter # BMPs to match adj cell to load red need =			**120.0**	112.1		$4,165	$4,165	$76,960	$4,540,116	$1044,221	$420,000
																			$6,004,337	

Municipal Residential

Loading = 0.56 lb/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)	BMP P Load Reduc Effic'y (%)	Per-BMP Annual P Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)	Per-BMP Annual O&M Cost ($/BMP-Yr)	Per-BMP Annual O&M Cost ($/BMP-Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater Wetland	4.5	0.10	$7,977	$63,276	$6,549	$14,526	$1994	$3,500	40%	1.01	15%	5.4	5.4		$338	$338	$1827	$78,441	$10,769	$18,900
Bioretention	0.9	0.02	$5,590	$63,276	$1546	$7,137	$1398	$3,500	45%	0.21	25%	9.0	19		$200	$200	$1802	$64,230	$12,578	$31500
Wet Detention	8.0	0.14	$56,256	$63,276	$8,732	$64,989	$14,064	$3,500	40%	1.79	50%	18.0	32.3		$961	$961	$17,305	$1,169,794	$253,154	$63,000
Extended Dry Det.	8.0	0.14	$56,256	$63,276	$8,732	$64,989	$14,064	$3,500	10%	0.45	2%	0.7	0.3		$961	$961	$692	$46,792	$10,126	$2,520
Grassed Swale	10	0.01	$250	$63,276	$726	$976	$63	$3,500	20%	0.11	2%	0.7	0.1	41	$205	$205	$148	$703	$45	$2,520
Filter Strip/Level Spreader	2.5	0.29	$7,575	$63,276	$18,158	$25,733	$1894	$3,500	35%	0.49	2%	0.7	0.4		$236	$236	$170	$18,528	$1364	$2,520
Infiltration Devices	2.5	0.05	$8,800	$63,276	$3,296	$12,096	$2,200	$3,500	35%	0.49	0%	0.0	0.0		$236	$236	$0	$0	$0	$0
Buffer w/Level Spreader	2.3	0.46	$357	$63,276	$29,107	$29,463	$89	$3,500	35%	0.45	0%	0.0	0.0		$233	$233	$0	$0	$0	$0
Sand Filter	15	0.03	$70,084	$63,276	$1905	$71989	$17,521	$3,500	45%	0.39	4%	1.4	0.6		$794	$794	$1,143	$103,664	$25,230	$5,040
						$291897	$53,287		Enter # BMPs to match adj cell to load red need =			36.0	40.9		$4,165	$4,165	$23,088	$1482,152	$313,266	$126,000
																			$1921418	

Commercial/Industial

Loading = 0.68 lb/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)	BMP P Load Reduc Effic'y (%)	Per-BMP Annual P Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)	Per-BMP Annual O&M Cost ($/BMP-Yr)	Per-BMP Annual O&M Cost ($/BMP-Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater Wetland	4.5	0.10	$7,977	$230,029	$23,808	$31,785	$1994	$3,500	40%	1.22	15%	2.3	2.8		$338	$338	$761	$71,516	$4,487	$7,875
Bioretention	0.9	0.02	$5,590	$230,029	$5,621	$11212	$1398	$3,500	45%	0.26	25%	3.8	10		$200	$200	$751	$42,044	$5,241	$13,125
Wet Detention	8.0	0.14	$56,256	$230,029	$31744	$88,000	$14,064	$3,500	40%	2.18	50%	7.5	16.3		$961	$961	$7,211	$660,003	$105,481	$26,250
Extended Dry Det.	8.0	0.14	$56,256	$230,029	$31744	$88,000	$14,064	$3,500	10%	0.54	2%	0.3	0.2		$961	$961	$288	$26,400	$4,219	$1050
Grassed Swale	10	0.01	$250	$230,029	$2,640	$2,890	$63	$3,500	20%	0.14	2%	0.3	0.0	20	$205	$205	$62	$867	$19	$1050
Filter Strip/Level Spreader	2.5	0.29	$7,575	$230,029	$66,009	$73,584	$1894	$3,500	35%	0.60	2%	0.3	0.2		$236	$236	$71	$22,075	$568	$1050
Infiltration Devices	2.5	0.05	$8,800	$230,029	$11981	$20,781	$2,200	$3,500	35%	0.60	0%	0.0	0.0		$236	$236	$0	$0	$0	$0
Buffer w/Level Spreader	2.3	0.46	$357	$230,029	$105,813	$106,170	$89	$3,500	35%	0.55	0%	0.0	0.0		$233	$233	$0	$0	$0	$0
Sand Filter	15	0.03	$70,084	$230,029	$6,925	$77,010	$17,521	$3,500	45%	0.47	4%	0.6	0.3		$794	$794	$476	$46,206	$10,513	$2,100
						$499,432	$53,287		Enter # BMPs to match adj cell to load red need =			15.0	20.7		$4,165	$4,165	$9,620	$869,112	$130,528	$52,500
																			$1052,140	

*Phosphorus is the limiting factor, therefore all calculations based on Phosphorus reductions.

County	(<20% Imp)	0.46
Muni	(20-49%)	0.56
Comm/Indus	(50-100%)	0.68

To change Loading Value, Click on "Tools", then "Scenarios", then chose the Scenario.

2013 Total # BMPs Needed

171

2013 Grand Total BMP O&M Cost

$12,496	$12,496	$109,668

2013 Grand Total Developer Costs

Capital ($/yr)	Planning ($/yr)	Reg Trans ($/yr)
$6,891379	$1,488,015	$598,500
	$8,977,895	

Table B.6. Conservative P BMP Cost Efficiency and Annual Cost Using HBA Data for 2013

Substituted HBA values everywhere provided. HBA input values are bolded in calculation tables.

Comm/Ind (Raleigh)	DA (Ac)	BMP Area	Land Cost	Land Cost/Ac	Per-BMP Construct Cost	RTC (Add'l to Permit)
Wet Pond	17.09	1.3	$ 366,178	$ 281,675	$ 60,288	$ 12,000
Const Wetland	10.01	0.75	$ 196,351	$ 261,588	$ 100,000	$ 15,000
Wet Pond	12.25	0.95	$ 260,709	$ 274,431	$ 43,113	$ 12,000
Const Wetland	3.91	0.23	$ 38,233	$ 166,230	$ 39,927	$ 15,000
Bioretention	16.93	1	$ 166,230	$ 166,230	$ 231,176	$ 15,000
AVERAGES						
Wet Pond	14.67	1.125	$ 313,444		$ 51,701	
Const Wetland	6.96	0.49	$ 117,212		$ 69,964	
			Avg = $ 230,031			$ 13,800

Muni Res (Cary)	DA (Ac)	BMP Area	Land Cost	Land Cost/Ac	Per-BMP Construct Cost	RTC (Add'l to Permit)
Wet Pond	6.46	0.55	$ 34,802	$ 63,278	$ 29,700	$ 12,000
Wet Pond	10.77	0.67	$ 42,396	$ 63,278	$ 41,970	$ 12,000
Wet Pond	9.74	0.9	$ 56,949	$ 63,277	$ 58,400	$ 12,000
Wet Pond	6.11	0.41	$ 25,944	$ 63,278	$ 29,475	$ 12,000
Wet Pond	3.48	0.3	$ 18,983	$ 63,277	$ 26,280	$ 12,000
AVERAGE	7.312	0.566	$ 35,815	$ 63,277	$ 37,165	$ 12,000

PHOSPHORUS — **BMP Unit Capital Costs** — **Number of BMPs to Reduce 2013 Load** — **BMP Unit and Total Annual O&M Costs, 2013** — **Developer Total Annual Costs, 2013**

County Residential

Loading = 0.46 lb/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)
Stormwater Wetland	4.5	0.10	$7,977	$30,098	$3,115	$11,092	$2,393	**$17,300**
Bioretention	0.9	0.02	$5,590	$30,098	$736	$6,326	$1,677	**$17,300**
Wet Detention	8.0	0.14	$56,256	$30,098	$4,154	$60,410	$16,877	**$17,300**
Extended Dry Det.	8.0	0.14	$56,256	$30,098	$4,154	$60,410	$16,877	**$17,300**
Grassed Swale	10	0.01	$250	$30,098	$345	$595	$75	**$17,300**
Filter Strip/Level Spreader	2.5	0.29	$7,575	$30,098	$8,637	$16,212	$2,273	**$17,300**
Infiltration Devices	2.5	0.05	$8,800	$30,098	$1,568	$10,368	$2,640	**$17,300**
Buffer w/Level Spreader	2.3	0.46	$357	$30,098	$13,845	$14,202	$107	**$17,300**
Sand Filter	15	0.03	$70,084	$30,098	$906	$70,990	$21,025	**$17,300**

BMP P Load Reduc Effic'y (%)	Per-BMP Annual P Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)
40%	0.83	15%	18	15	112
45%	0.18	25%	30	5	
40%	1.47	50%	60	88	
10%	0.37	2%	2	1	
20%	0.09	2%	2	0	
35%	0.40	2%	2	1	
35%	0.40	0%	0	0	
35%	0.37	0%	0	0	
45%	0.32	4%	5	2	
Enter # BMPs to match adj cell to load red need =>			120	112	

	Per-BMP Annual O&M Cost ($/BMP Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater Wetland	$338	$6,091	$199,660	$43,076	$311,400
Bioretention	$200	$6,007	$189,777	$50,313	$519,000
Wet Detention	$961	$57,685	$3,624,602	$1,012,616	$1,038,000
Extended Dry Det.	$961	$2,307	$144,984	$40,505	$41,520
Grassed Swale	$205	$493	$1,429	$180	$41,520
Filter Strip/Level Spreader	$236	$566	$38,909	$5,454	$41,520
Infiltration Devices	$236	$0	$0	$0	$0
Buffer w/Level Spreader	$233	$0	$0	$0	$0
Sand Filter	$794	$3,810	$340,754	$100,921	$83,040
	$4,155	$76,960	$4,540,116	$1,253,066	$2,076,000
				$7,869,181	

Muni Residential

Loading = .56 lb/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)
Stormwater Wetland	**7.0**	**0.49**	**$69,964**	**$63,277**	$31,006	$100,969	$20,989	**$17,300**
Bioretention	**16.9**	**1.00**	**$231,176**	**$63,277**	$63,277	$294,453	$69,353	**$17,300**
Wet Detention	**7.3**	**1.13**	**$37,165**	**$63,277**	$71,187	$108,352	$11,150	**$17,300**
Extended Dry Det.	8.0	0.14	$56,256	**$63,277**	$8,732	$64,989	$16,877	**$17,300**
Grassed Swale	10	0.01	$250	**$63,277**	$726	$976	$75	**$17,300**
Filter Strip/Level Spreader	2.5	0.29	$7,575	**$63,277**	$18,158	$25,733	$2,273	**$17,300**
Infiltration Devices	2.5	0.05	$8,800	**$63,277**	$3,296	$12,096	$2,640	**$17,300**
Buffer w/Level Spreader	2.3	0.46	$357	**$63,277**	$29,107	$29,464	$107	**$17,300**
Sand Filter	15	0.03	$70,084	**$63,277**	$1,905	$71,989	$21,025	**$17,300**

BMP P Load Reduc Effic'y (%)	Per-BMP Annual P Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)
40%	1.56	15%	3	4	41
45%	4.27	25%	5	20	
40%	1.64	50%	10	16	
10%	0.45	2%	0	0	
20%	0.11	2%	0	0	
35%	0.49	2%	0	0	
35%	0.49	0%	0	0	
35%	0.45	0%	0	0	
45%	0.39	4%	1	0	
Enter # BMPs to match adj cell to load red need =>			19	41	

	Per-BMP Annual O&M Cost ($/BMP Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater Wetland	$362	$1,031	$287,762	$59,819	$49,305
Bioretention	$316	$1,499	$1,398,652	$329,426	$82,175
Wet Detention	$938	$8,911	$1,029,341	$105,920	$164,350
Extended Dry Det.	$961	$365	$24,696	$6,413	$6,574
Grassed Swale	$205	$78	$371	$29	$6,574
Filter Strip/Level Spreader	$236	$90	$9,779	$864	$6,574
Infiltration Devices	$236	$0	$0	$0	$0
Buffer w/Level Spreader	$233	$0	$0	$0	$0
Sand Filter	$794	$603	$54,712	$15,979	$13,148
	$4,281	$12,577	$2,805,313	$518,449	$328,700
				$3,652,462	

Commercial/Industrial

Loading = 0.68 lb/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)
Stormwater Wetland	**7.0**	**0.49**	**$69,964**	**$230,031**	$112,715	$182,679	$20,989	**$17,300**
Bioretention	**16.9**	**1.00**	**$231,176**	**$230,031**	$230,031	$461,207	$69,353	**$17,300**
Wet Detention	**14.7**	**1.13**	**$51,701**	**$230,031**	$258,785	$310,485	$15,510	**$17,300**
Extended Dry Det.	8.0	0.14	$56,256	**$230,031**	$31,744	$88,001	$16,877	**$17,300**
Grassed Swale	10	0.01	$250	**$230,031**	$2,640	$2,890	$75	**$17,300**
Filter Strip/Level Spreader	2.5	0.29	$7,575	**$230,031**	$66,010	$73,585	$2,273	**$17,300**
Infiltration Devices	2.5	0.05	$8,800	**$230,031**	$11,981	$20,781	$2,640	**$17,300**
Buffer w/Level Spreader	2.3	0.46	$178	**$230,031**	$105,814	$105,992	$53	**$17,300**
Sand Filter	15	0.03	$70,084	**$230,031**	$6,926	$77,010	$21,025	**$17,300**

BMP P Load Reduc Effic'y (%)	Per-BMP Annual P Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)
40%	1.89	15%	1	2	20
45%	5.18	25%	2	8	
40%	3.99	50%	3	12	
10%	0.54	2%	0	0	
20%	0.14	2%	0	0	
35%	0.60	2%	0	0	
35%	0.60	0%	0	0	
35%	0.55	0%	0	0	
45%	0.47	4%	0	0	
Enter # BMPs to match adj cell to load red need =>			6	22	

	Per-BMP Annual O&M Cost ($/BMP Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater Wetland	$362	$326	$164,411	$18,890	$15,570
Bioretention	$316	$473	$691,810	$104,029	$25,950
Wet Detention	$1,132	$3,395	$931,456	$46,530	$51,900
Extended Dry Det.	$961	$115	$10,560	$2,025	$2,076
Grassed Swale	$205	$25	$347	$9	$2,076
Filter Strip/Level Spreader	$236	$28	$8,830	$273	$2,076
Infiltration Devices	$236	$0	$0	$0	$0
Buffer w/Level Spreader	$233	$0	$0	$0	$0
Sand Filter	$794	$191	$18,482	$5,046	$4,152
	$4,474	$4,553	$1,825,896	$176,803	$103,800
				$2,106,499	

*Phosphorus is the limiting factor, therefore all calculations based on Phosphorus reductions.

**Miscellanous Cost includes as-built surveys, inspection, turn over

County	(<20% Imp)	0.46
Muni	(20-49%)	0.56
Comm/Indus	(50-100%)	0.68

County	(<20% Imp)	2.8
Muni	(20-49%)	5.03
Comm/Indus	(50-100%)	8.38

To change Loading Value, Click on "Tools", then "Scenarios", then chose the Scenario.

2013 Total # BMPs Needed

145

2013 Grand Total BMP O&M Cost

$12,920	$94,090

2013 Grand Total Developer Costs

Absolute Capital Cost	Absolute Planning Cost	Absolute Reg Trans Cost
$9,171,325	$1,948,318	$2,508,500
	$13,628,142	

Table B.7. Conservative N BMP Cost Efficiency and Annual Cost for 2013

NITROGEN **BMP Unit Capital Costs** | **Number of BMPs to Reduce 2013 Load** | **BMP Unit and Total Annual O&M Costs, 2013** | **Developer Total Annual Costs, 2013**

County Residential

Loading = 2.8 lb N/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)	BMP N Load Reduc Effic'y (%)	Per-BMP Annual N Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)		Per-BMP Annual O&M Cost ($/BMP-Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater	4.5	0.10	$7,977	$30,098	$3,115	$11,092	$2,393	**$17,300**	40%	5.0	15%	20	100	516	Stormwater	$338	$6,701	$219,626	$47,384	$342,540
Bioretention	0.9	0.02	$5,590	$30,098	$736	$6,326	$1,677	**$17,300**	35%	0.8	25%	33	27		Bioretention	$200	$6,608	$208,755	$55,345	$570,900
Wet Detention	8.0	0.14	$56,256	$30,098	$4,154	$60,410	$16,877	**$17,300**	25%	5.6	50%	66	370		Wet	$961	$63,453	$3,987,063	$1,113,878	$1,141,800
Extended Dry	8.0	0.14	$56,256	$30,098	$4,154	$60,410	$16,877	**$17,300**	10%	2.2	2%	3	6		Extended	$961	$2,538	$159,483	$44,555	$45,672
Grassed Swale	1.0	0.01	$250	$30,098	$345	$595	$75	**$17,300**	20%	0.6	2%	3	1		Grassed	$205	$542	$1,572	$198	$45,672
Filter Strip/Level	2.5	0.29	$7,575	$30,098	$8,637	$16,212	$2,273	**$17,300**	20%	1.4	2%	3	4		Filter	$236	$623	$42,800	$5,999	$45,672
Infiltration	2.5	0.05	$8,800	$30,098	$1,568	$10,368	$2,640	**$17,300**	30%	2.1	0%	0	0		Infiltration	$236	$0	$0	$0	$0
Buffer w/Level	2.3	0.46	$357	$30,098	$13,845	$14,202	$107	**$17,300**	30%	1.9	0%	0	0		Buffer	$233	$0	$0	$0	$0
Sand Filter	1.5	0.03	$70,084	$30,098	$906	$70,990	$21,025	**$17,300**	35%	1.5	4%	5	8		Sand Filter	$794	$4,191	$374,829	$111,013	$91,344
								Totals	Enter #BMPs to match adj cell to load red need =>			**132**	516			$4,165	$84,656	$4,994,127	$1,378,372	$2,283,600
																			$8,656,099	

Muni Residential

Loading = 5.03 lb N/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)	BMP N Load Reduc Effic'y (%)	Per-BMP Annual N Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)		Per-BMP Annual O&M Cost ($/BMP-Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater	**7.0**	**0.49**	**$69,964**	**$63,277**	$31,006	$100,969	$20,989	**$17,300**	40%	14.0	15%	3	44	300	Stormwater	$362	$1,129	$315,024	$65,486	$53,976
Bioretention	**16.9**	**1.00**	**$231,176**	**$63,277**	$63,277	$294,453	$69,353	**$17,300**	35%	29.8	25%	5	155		Bioretention	$316	$1,641	$1,531,156	$360,635	$89,960
Wet Detention	**7.3**	**1.13**	**$37,165**	**$63,277**	$71,187	$108,352	$11,150	**$17,300**	25%	9.2	50%	10	95		Wet	$938	$9,755	$1,126,858	$115,955	$179,920
Extended Dry	8.0	0.14	$56,256	**$63,277**	$8,732	$64,989	$16,877	**$17,300**	10%	4.0	2%	0	2		Extended	$961	$400	$27,035	$7,021	$7,197
Grassed Swale	1.0	0.01	$250	**$63,277**	$726	$976	$75	**$17,300**	20%	1.0	2%	0	0		Grassed	$205	$85	$406	$31	$7,197
Filter Strip/Level	2.5	0.29	$7,575	**$63,277**	$18,158	$25,733	$2,273	**$17,300**	20%	2.5	2%	0	1		Filter	$236	$98	$10,705	$945	$7,197
Infiltration	2.5	0.05	$8,800	**$63,277**	$3,296	$12,096	$2,640	**$17,300**	30%	3.8	0%	0	0		Infiltration	$236	$0	$0	$0	$0
Buffer w/Level	2.3	0.46	$357	**$63,277**	$29,107	$29,464	$107	**$17,300**	30%	3.5	0%	0	0		Buffer	$233	$0	$0	$0	$0
Sand Filter	1.5	0.03	$70,084	**$63,277**	$1,905	$71,989	$21,025	**$17,300**	35%	2.7	4%	1	2		Sand Filter	$794	$660	$59,895	$17,493	$14,394
								Totals	Enter #BMPs to match adj cell to load red need =>			**21**	300			$4,281	$13,769	$3,071,079	$567,566	$359,840
																			$3,998,485	

Commercial/Industrial

Loading = 8.38 lb N/ac/yr	BMP Drainage Area (Ac)	BMP Footprint (Ac)	Per-BMP Install Cost ($/BMP)	Avg Per-Acre Land Cost ($/ac)	Per-BMP Land Cost ($/BMP)	Per-BMP Capital Cost (Install + Land) ($/BMP)	Per-BMP Planning Costs ($/BMP)	Per-BMP Reg Trans Costs ($/BMP)	BMP N Load Reduc Effic'y (%)	Per-BMP Annual N Load Reduc (lb/yr)	Developer Likely BMP Proportions (%)	Number of BMPs for Yearly Reduction	Reduction Allocated Among BMPs (lb/yr)	Total Annual Load Reduc Needed (lb/yr)		Per-BMP Annual O&M Cost ($/BMP-Yr)	2013 Total O&M Cost ($/yr)	2013 Total Capital Cost ($/yr)	2013 Total Planning Cost ($/yr)	2013 Total Reg Trans Cost ($/yr)
Stormwater	**7.0**	**0.49**	**$69,964**	**$230,031**	$112,715	$182,679	$20,989	**$17,300**	40%	23.3	15%	1	15	136	Stormwater	$362	$233	$117,828	$13,538	$11,159
Bioretention	**16.9**	**1.00**	**$231,176**	**$230,031**	$230,031	$461,207	$69,353	**$17,300**	35%	49.7	25%	1	53		Bioretention	$316	$339	$495,797	$74,554	$18,598
Wet Detention	**14.7**	**1.13**	**$51,701**	**$230,031**	$258,785	$310,485	$15,510	**$17,300**	25%	30.7	50%	2	66		Wet	$1,132	$2,433	$667,543	$33,347	$37,195
Extended Dry	8.0	0.14	$56,256	**$230,031**	$31,744	$88,001	$16,877	**$17,300**	10%	6.7	2%	0	1		Extended	$961	$83	$7,568	$1,451	$1,488
Grassed Swale	1.0	0.01	$250	**$230,031**	$2,640	$2,890	$75	**$17,300**	20%	1.7	2%	0	0		Grassed	$205	$18	$249	$6	$1,488
Filter Strip/Level	2.5	0.29	$7,575	**$230,031**	$66,010	$73,585	$2,273	**$17,300**	20%	4.2	2%	0	0		Filter	$236	$20	$6,328	$195	$1,488
Infiltration	2.5	0.05	$8,800	**$230,031**	$11,981	$20,781	$2,640	**$17,300**	30%	6.3	0%	0	0		Infiltration	$236	$0	$0	$0	$0
Buffer w/Level	2.3	0.46	$178	**$230,031**	$105,814	$105,992	$53	**$17,300**	30%	5.8	0%	0	0		Buffer	$233	$0	$0	$0	$0
Sand Filter	1.5	0.03	$70,084	**$230,031**	$6,926	$77,010	$21,025	**$17,300**	35%	4.5	4%	0	1		Sand Filter	$794	$137	$13,246	$3,616	$2,976
								totals	Enter #BMPs to match adj cell to load red need =>			**4**	136			$4,474	$3,263	$1,308,559	$126,709	$74,390
																			$1,509,658	
									Total			**157**			**Grand**	$12,920	$101,688	**Grand** Capital	Planning	Reg Trans
																		$9,373,765	$2,072,646	$2,717,830
																			$14,164,242	

County	Imp)	2.8
Muni	(20-49%)	5.03
Comm/Indus	(50-100%)	8.38

Table B.8. Total 25 Year Cost Summary Analysis

Year	Regul'y Dev't	Permitting	Monitoring/ Recordkeep'g	**Inflated** Monitoring/Recordkeeping	Inspection /Enforcement ($360/ BMP/yr)	**Inflated** Inspection/Enforcement	**Inflated** Local Gov't Dev't Projects Load Reduc Cost - Low	**Inflated** Local Gov't Dev't Projects Load Reduc Cost - High	**Inflated** Local Gov't Cummulative O&M costs - High	Sum of RD, Perm, M&R, I&E Costs	**Inflation Factor vs 2010 (CPI)**	**Inflated** Total Cost - Low	**Inflated** Total Cost - High
2011	$163,000	$0	$56,000	$56,989	$0	$0	$0	$0	$0	$219,000	1.02	$222,868	$222,868
2012	$0	$0	$28,000	$29,119	$67,320	$70,010	$15,029	$171,847	$531	$95,320	1.04	$114,157	$271,506
2013	$0	$0	$28,000	$29,739	$68,459	$72,712	$15,622	$178,628	$1,083	$96,459	1.06	$118,073	$282,163
2014	$0	$0	$28,000	$30,327	$69,618	$75,403	$16,220	$185,463	$1,656	$97,618	1.08	$121,950	$292,849
2015	$0	$0	$28,000	$30,921	$70,796	$78,181	$16,844	$192,603	$2,249	$98,796	1.10	$125,947	$303,955
2016	$0	$0	$28,000	$31,544	$71,994	$81,105	$17,510	$200,217	$2,865	$99,994	1.13	$130,159	$315,731
2017	$0	$0	$28,000	$32,159	$73,212	$84,087	$18,198	$208,080	$3,503	$101,212	1.15	$134,443	$327,829
2018	$0	$0	$28,000	$32,770	$74,451	$87,133	$18,909	$216,216	$4,164	$102,451	1.17	$138,812	$340,283
2019	$0	$0	$28,000	$33,354	$75,711	$90,189	$19,631	$224,466	$4,849	$103,711	1.19	$143,173	$352,857
2020	$0	$0	$28,000	$33,921	$76,992	$93,272	$20,366	$232,881	$5,557	$104,992	1.21	$147,559	$365,630
											Stg I Total	**$1,397,141**	**$3,075,671**
											Stg I NPV	**$991,346**	**$2,106,276**
2021	$0	$0	$28,000	$34,467	$78,295	$96,377	$21,115	$241,441	$6,288	$106,295	1.23	$151,959	$378,573
2022	$0	$0	$28,000	$35,021	$79,620	$99,583	$21,897	$250,384	$7,044	$107,620	1.25	$156,501	$392,032
2023	$0	$0	$28,000	$35,595	$80,967	$102,929	$22,725	$259,844	$7,825	$108,967	1.27	$161,249	$406,193
2024	$0	$0	$28,000	$36,219	$82,337	$106,505	$23,624	$270,126	$8,633	$110,337	1.29	$166,348	$421,484
2025	$0	$0	$28,000	$36,872	$83,730	$110,261	$24,584	$281,106	$9,470	$111,730	1.32	$171,717	$437,709
2026	$0	$0	$28,000	$37,547	$85,147	$114,180	$25,603	$292,758	$10,337	$113,147	1.34	$177,330	$454,822
2027	$0	$0	$28,000	$38,247	$86,588	$118,276	$26,687	$305,149	$11,235	$114,588	1.37	$183,209	$472,906
2028	$0	$0	$28,000	$38,976	$88,053	$122,571	$27,845	$318,397	$12,165	$116,053	1.39	$189,392	$492,109
2029	$0	$0	$28,000	$39,722	$89,543	$127,031	$29,071	$332,411	$13,129	$117,543	1.42	$195,824	$512,292
2030	$0	$0	$28,000	$40,480	$91,059	$131,644	$30,363	$347,181	$14,128	$119,059	1.45	$202,486	$533,433
2031	$0	$0	$28,000	$41,253	$92,600	$136,430	$31,729	$362,810	$15,164	$120,600	1.47	$209,412	$555,657
2032	$0	$0	$28,000	$42,032	$94,167	$141,359	$33,164	$379,216	$16,237	$122,167	1.50	$216,555	$578,844
2033	$0	$0	$28,000	$42,826	$95,760	$146,464	$34,681	$396,561	$17,348	$123,760	1.53	$223,971	$603,199
2034	$0	$0	$28,000	$43,639	$97,380	$151,770	$36,292	$414,978	$18,500	$125,380	1.56	$231,700	$628,886
2035	$0	$0	$28,000	$44,470	$99,028	$157,280	$38,002	$434,537	$19,694	$127,028	1.59	$239,752	$655,981
Totals	$163,000	$0	$728,000	$928,208	$1,972,827	$2,594,752	$585,709	$6,697,299	$213,653	$2,644,827	**Stg II Total**	**$2,877,406**	**$7,524,120**
NPV	$152,336	$0	$352,469	$420,846	$835,774	$1,037,528	$230,420	$2,634,739	$68,534	$1,340,579	**Stg II NPV**	**$852,475**	**$2,210,399**
											Stg I+II Total	**$4,274,547**	**$10,599,790**
											Stg I+II NPV	**$1,843,821**	**$4,316,675**

Table B.9. Low Estimate Private Cost, Inflated 25 Year Implementation of New Development

Low Estimate Developer Costs, Inflated					Low Est Prop Owner Costs, Inflated		
Year	**Total Developer Cost**	**Capital**	**Planning**	**Reg Trans**	**O&M Increment ($/yr)**	**Cumulative O&M**	**Inflation Factor vs 2010 (CPI)**
2011	0	0	0	0	0	0	1.02
2012	$7,354,590	$5,193,665	$1,194,537	$966,389	$88,039	$88,039	1.04
2013	$7,638,471	$5,394,136	$1,240,645	$1,003,690	$91,437	$179,475	1.06
2014	$7,921,196	$5,593,790	$1,286,565	$1,040,840	$94,821	$274,297	1.08
2015	$8,213,040	$5,799,885	$1,333,967	$1,079,188	$98,315	$372,611	1.10
2016	$8,520,178	$6,016,780	$1,383,852	$1,119,546	$101,991	$474,603	1.13
2017	$8,833,387	$6,237,961	$1,434,724	$1,160,702	$105,741	$580,343	1.15
2018	$9,153,436	$6,463,974	$1,486,706	$1,202,756	$109,572	$689,915	1.17
2019	$9,474,393	$6,690,627	$1,538,836	$1,244,929	$113,414	$803,329	1.19
2020	$9,798,311	$6,919,372	$1,591,447	$1,287,492	$117,291	$920,620	1.21
Stg I Total	**$76,907,002**	**$54,310,190**	**$12,491,280**	**$10,105,532**	**$920,620**	**$4,383,232**	
Stg I NPV	**$51,198,011**	**$36,155,014**	**$8,315,611**	**$6,727,387**	**$612,869**	**$2,682,476**	
2021	$10,124,542	$7,149,749	$1,644,434	$1,330,358	$121,196	$1,041,817	1.23
2022	$10,461,337	$7,387,587	$1,699,136	$1,374,613	$125,228	$1,167,045	1.25
2023	$10,812,834	$7,635,808	$1,756,227	$1,420,800	$129,436	$1,296,481	1.27
2024	$11,188,463	$7,901,069	$1,817,237	$1,470,157	$133,932	$1,430,413	1.29
2025	$11,583,006	$8,179,688	$1,881,319	$1,522,000	$138,655	$1,569,068	1.32
2026	$11,994,746	$8,470,450	$1,948,194	$1,576,102	$143,584	$1,712,652	1.34
2027	$12,424,960	$8,774,259	$2,018,069	$1,632,632	$148,734	$1,861,386	1.37
2028	$12,876,190	$9,092,909	$2,091,358	$1,691,923	$154,135	$2,015,521	1.39
2029	$13,344,687	$9,423,752	$2,167,452	$1,753,484	$159,743	$2,175,264	1.42
2030	$13,829,311	$9,765,983	$2,246,165	$1,817,163	$165,545	$2,340,809	1.45
2031	$14,332,074	$10,121,024	$2,327,824	$1,883,226	$171,563	$2,512,372	1.47
2032	$14,849,869	$10,486,681	$2,411,924	$1,951,264	$177,761	$2,690,133	1.50
2033	$15,386,214	$10,865,437	$2,499,038	$2,021,739	$184,182	$2,874,315	1.53
2034	$15,943,534	$11,259,005	$2,589,558	$2,094,970	$190,853	$3,065,168	1.56
2035	$16,522,390	$11,667,782	$2,683,576	$2,171,032	$197,782	$3,262,950	1.59
Stg II Total	**$195,674,157**	**$138,181,184**	**$31,781,510**	**$25,711,463**	**$2,342,330**	**$31,015,392**	
Stg II NPV	**$57,795,343**	**$40,813,918**	**$9,387,153**	**$7,594,272**	**$691,843**	**$8,672,466**	
Stg I+II Total	**$272,581,159**	**$192,491,374**	**$44,272,790**	**$35,816,995**	**$3,262,950**	**$35,398,624**	
Stg I+II NPV	**$108,993,354**	**$76,968,931**	**$17,702,764**	**$14,321,659**	**$1,304,712**	**$11,354,941**	

Table B.10. High Estimate Private Cost, Inflated 25 Year Implementation of New Development, HBA Data

Appendix B: New Development

Inflation Factor vs 2010 (CPI)	Conservative Estimate Developer Costs, Inflated					Conserv Est Prop Owner Costs, Inflated	
	Year	Total Developer Cost	Capital	Planning	Reg Trans	O&M Increment ($/yr)	Cumulative O&M
1.02	2011	0	0	0	0	0	0
1.04	2012	$14,558,319	$9,611,650	$2,133,797	$2,812,872	$105,219	$105,219
1.06	2013	$15,120,258	$9,982,652	$2,216,160	$2,921,446	$109,281	$214,500
1.08	2014	$15,679,908	$10,352,142	$2,298,187	$3,029,579	$113,326	$327,826
1.10	2015	$16,257,610	$10,733,551	$2,382,861	$3,141,199	$117,501	$445,327
1.13	2016	$16,865,586	$11,134,947	$2,471,971	$3,258,668	$121,895	$567,222
1.15	2017	$17,485,579	$11,544,277	$2,562,843	$3,378,460	$126,376	$693,598
1.17	2018	$18,119,112	$11,962,546	$2,655,699	$3,500,867	$130,955	$824,553
1.19	2019	$18,754,443	$12,382,003	$2,748,819	$3,623,622	$135,547	$960,100
1.21	2020	$19,395,635	$12,805,328	$2,842,797	$3,747,509	$140,181	$1,100,281
	Stg I Total	**$152,236,452**	**$100,509,095**	**$22,313,134**	**$29,414,223**	**$1,100,281**	**$5,238,628**
	Stg I NPV	**$101,345,825**	**$66,910,238**	**$14,854,149**	**$19,581,438**	**$732,472**	**$3,205,966**
1.23	2021	$20,041,404	$13,231,676	$2,937,447	$3,872,281	$144,848	$1,245,129
1.25	2022	$20,708,086	$13,671,831	$3,035,162	$4,001,093	$149,667	$1,394,796
1.27	2023	$21,403,870	$14,131,199	$3,137,142	$4,135,529	$154,695	$1,549,491
1.29	2024	$22,147,424	$14,622,106	$3,246,124	$4,279,194	$160,069	$1,709,561
1.32	2025	$22,928,416	$15,137,730	$3,360,593	$4,430,092	$165,714	$1,875,274
1.34	2026	$23,743,450	$15,675,830	$3,480,052	$4,587,568	$171,605	$2,046,879
1.37	2027	$24,595,054	$16,238,073	$3,604,871	$4,752,110	$177,759	$2,224,638
1.39	2028	$25,488,258	$16,827,782	$3,735,787	$4,924,690	$184,215	$2,408,854
1.42	2029	$26,415,643	$17,440,057	$3,871,712	$5,103,874	$190,918	$2,599,771
1.45	2030	$27,374,949	$18,073,407	$4,012,317	$5,289,225	$197,851	$2,797,622
1.47	2031	$28,370,162	$18,730,463	$4,158,184	$5,481,514	$205,044	$3,002,666
1.50	2032	$29,395,131	$19,407,166	$4,308,413	$5,679,553	$212,452	$3,215,118
1.53	2033	$30,456,819	$20,108,110	$4,464,023	$5,884,686	$220,125	$3,435,243
1.56	2034	$31,560,026	$20,836,466	$4,625,719	$6,097,841	$228,098	$3,663,341
1.59	2035	$32,705,865	$21,592,968	$4,793,664	$6,319,233	$236,380	$3,899,721
	Stg II Total	**$387,334,557**	**$255,724,864**	**$56,771,211**	**$74,838,482**	**$2,799,440**	**$37,068,105**
	Stg II NPV	**$114,405,162**	**$75,532,234**	**$16,768,242**	**$22,104,686**	**$826,857**	**$10,364,914**
	Stg I+II Total	**$539,571,009**	**$356,233,959**	**$79,084,345**	**$104,252,704**	**$3,899,721**	**$42,306,733**
	Stg I+II NPV	**$215,750,987**	**$142,442,472**	**$31,622,391**	**$41,686,124**	**$1,559,329**	**$13,570,880**

Table B.11. New Development Homebuilders Census 2009

2009 BUILDER Member Census

Q2. Average number of construction and non-construction paid employees (including yourself) on this company's payroll

(Percent of Respondents)

Total Employees	
Zero Employees	2
1 Employee	16
2-4 Employees	41
5-9 Employees	23
10-49 Employees	15
50-99 Employees	2
100 Employees or more	1
Average	10
Median	4

Percent of respondents:

<5 employees:
58%

<10 employees:
81%

<100 employees:
99%

Q4. What do you expect the dollar volume of this company's business activity to be in ...?

(Percent of Respondents)

Under $500,000	31
$500,000 to $999,999	22
$1 million to $4,999,999	33
$5 million to $9,999,999	6
$10 million to $14,999,999	2
$15 million or over	4
No business activity	1
Median	$912,541

<$5 million:
87%

Appendix C: Existing Development

Table C.1. Existing Development Input Land Cover Data and Population Projection

Land Cover 2001		Upper5	Lower	Total
HU_Sq_Mi		642	129	771
HU_AC		410,996	82,740	493,736
Dry_sq_mi		633	119	752
Dry_acres		405,352	76,152	481,504
Pop_density		249	430	278
dwelling units		63,707	18,422	82,129
DU/dry acre		0.16	0.24	0.17
Population	2000	157,662	51,167	208,829
Pop_2001	2001	**160,452**	**53,006**	**213,458**
	2002	163,243	54,845	218,088
	2003	166,033	56,685	222,717
	2004	168,823	58,524	227,347
	2005	171,613	60,363	231,976
	2006	**174,403**	**62,203**	**236,606**
	2007	177,193	64,042	241,235
	2008	179,983	65,881	245,865
	2009	182,773	67,721	250,494
Pop_2010	2010	185,563	69,560	255,123
	2011	188,196	71,475	259,672
	2012	**190,829**	**73,390**	**264,220**
Pop_2013	2013	193,462	75,305	268,768

Population Increases	Upper5	Lower	Total
Pop. Growth #'01=>'06	13,950	9,197	23,147
%'01=>'06	8.69%	17.35%	10.84%
Pop. Growth #'06=>'12	16,426	11,187	27,614
%'06->'12	9.42%	17.99%	11.67%
Pop. Growth #'01->'12	30,377	20,384	50,761
%'01->'12	20.57%	42.07%	25.91%

Calculating Existing D Load Reduction Needs

	Population, 2001	%Growth 2006	% Growth 2013
Upper 5	13,950	**8.69%**	**9.42%**
Lower	9,197	**17.35%**	**17.99%**
Total	23,147	**10.84%**	**11.67%**

	Land Cover 2001 (Ac) County Residental	Muni Res.	Commer/Industial	All Developed
Upper 5	26,185	6,883	3,754	36,822
Lower	13,312	2,968	704	16,984
Total	**39,497**	**9,851**	**4,458**	**53,806**

Table C.2. Existing Development Calculation of Load Reduction Need

	Project Existing D Acres to 2006, x % pop. growth '01=>'06			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	28,462	7,481	4,080	40,023
Lower	15,622	3,483	826	19,931
Total	**44,083**	**10,964**	**4,906**	**59,954**
	Added Acres '01=>'06			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	2,277	598	326	3,201
Lower	2,310	515	122	2,947
Total	**4,586**	**1,113**	**448**	**6,148**
	Project Existing D Acres to 2012, x % pop. growth '06=>'12			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	31,142	8,186	4,464	43,793
Lower	18,431	4,109	975	23,515
Total	**49,574**	**12,295**	**5,439**	**67,308**
	Added Acres '06=>'12			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	2,681	705	384	3,770
Lower	2,810	626	149	3,585
Total	**5,490**	**1,331**	**533**	**7,354**

Table C.3. Continuation of Existing Development Calculation of Reduction Need

	Developed Unit-Area Loading Rates			
	Untreated Unit-Area Loading Rates			
Land Cover	**County Residental**	**Muni Res**	**Commer/Industial**	
N (lb/ac/yr)	2.80	7.50	12.50	
P (lb/ac/yr)	0.46	0.90	1.10	
	Neuse/WSW/Phase II-Treated Unit-Area Loading Rates			
Land Cover	**County Residential**	**Muni Res**	**Commer/Industial**	
N (lb/ac/yr)	2.80	5.03	8.38	
P (lb/ac/yr)	0.46	0.52	0.72	
	Pounds N/yr in 2001* (**Raw** U.A. Loading Rates)			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	73,318	51,623	46,920	171,860
Lower	37,274	22,260	8,800	68,334
Total	**110,592**	**73,883**	**55,720**	**240,194**
	Pounds P/yr in 2001* untreated U.A. Loading Rates			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	12,045	6,195	4,129	22,369
Lower	6,124	2,671	774	9,569
Total	**18,169**	**8,866**	**4,903**	**31,938**
	Pounds N/yr in 2006			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	79,693	54,633	49,655	183,980
Lower	43,741	24,850	9,824	78,415
Total	**123,433**	**79,483**	**59,478**	**262,394**
	Raw	WSW-treated	WSW-treated	
	Pounds P/yr in 2006			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	13,092	6,506	4,364	23,962
Lower	7,186	2,939	862	10,987
Total	**20,278**	**9,445**	**5,226**	**34,949**
	Raw	WSW-treated	WSW-treated	
	Pounds N/yr in 2012			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	87,199	58,177	52,875	198,250
Lower	51,608	28,001	11,069	90,678
Total	**138,806**	**86,178**	**63,943**	**288,928**
	Raw	WSW-treated	WSW-treated	
	Pounds P/yr in 2012			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	14,325	6,872	4,641	25,838
Lower	8,478	3,265	969	12,712
Total	**22,804**	**10,137**	**5,610**	**38,551**
	Raw	WSW-treated	WSW-treated	

Table C.4. Continuation of Existing Development Calculation of Reduction Need

	Added Pounds N/yr '01=>'06			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	6,375	3,010	2,735	12,120
Lower	6,467	2,590	1,024	10,081
Total	**12,842**	**5,600**	**3,758**	**22,201**
	Added Pounds P/yr '01=>'06			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	1,047	311	235	1,593
Lower	1,062	268	88	1,418
Total	**2,110**	**579**	**323**	**3,012**
	Added Pounds N/yr '06=>'12			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	7,506	3,544	3,220	14,271
Lower	7,867	3,151	1,245	12,263
Total	**15,373**	**6,695**	**4,465**	**26,534**
	Added Pounds P/yr '06=>'12			
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	1,233	366	277	1,876
Lower	1,292	326	107	1,725
Total	**2,526**	**692**	**384**	**3,601**
Stage 1 Nitrogen Reduction Goals as N Load Added '06=>'12 (lb N/yr)				
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	7,506	3,544	3,220	14,271
Lower	7,867	3,151	1,245	12,263
Total	**15,373**	**6,695**	**4,465**	**26,534**
Stage 1 Phosphorus Reduction Goals as P Load Added '06=>'12 (lb P/yr)				
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	1,233	366	277	1,876
Lower	1,292	326	107	1,725
Total	**2,526**	**692**	**384**	**3,601**
Stage II 40% Nitrogen Load Reduction from 2006 Baseline (lb N/yr)				
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	31,877	21,853	19,862	**73,592**
Stage II 77% Phosphorus Load Reduction from 2006 Baseline (lb P/yr)				
	County Residental	**Muni Res.**	**Commer/Industial**	**All Developed**
Upper 5	10,081	5,010	3,360	**18,451**

Table C.5. Existing Development Input Data Extracted from RTI Report with Additions for Falls Lake Watershed

Table 5-2. Nutrient Mitigation Project Costs[a]		Median Cost	Lower Range	Upper Range	Cost/Year	
Stormwater Retrofit Practice		($/lb-30 N)[b]	($/lb-30 N)[b]	($/lb-30 N)[b]	Stage1 N	Stage2 N
Wet ponds	0	$177	$88	$317	$0	$0
Wetlands	0.3037	$110	$55	$198	$886,421	$2,458,488
Large bioretention areas	0.133	$265	$188	$433	$935,191	$2,593,750
Small bioretention areas	0.133	$755	$628	$1,007	$2,664,412	$7,389,741
Sand filters	0	$503	$403	$553	$0	$0
Riparian buffers *	0.1263	$19.80	$16.80	$30.90	$66,355	$184,034
Infiltration practices	0.2533	$240	$160	$368	$1,613,055	$4,473,805
Water quality swales	0.0507	$550	$308	$968	$739,901	$2,052,113
					$6,905,334	$19,151,931
					Stage1 N	Stage2 N

		Median Cost	Lower Range	Upper Range	Cost/Year	
Stormwater Retrofit Practice		($/0.10 lb-30 P)c	($/0.10lb-30 P)c	($/0.10lb-30 P)c	Stage1 P	Stage2 P
Wet ponds	0	$93	$47	$168	$0	$0
Wetlands	0.3037	$107	$53	$192	$1,363,853	$5,995,819
Large bioretention areas	0.133	$174	$125	$286	$971,270	$4,269,930
Small bioretention areas	0.133	$498	$415	$664	$2,779,841	$12,220,835
Sand filters	0	$332	$266	$365	$0	$0
Riparian buffers *	0.1263	$30.70	$26.20	$48.00	$162,735	$715,421
Infiltration practices	0.2533				$0	$0
Water quality swales	0.0507	$466	$262	$822	$991,592	$4,359,270
					$6,269,290	$27,561,275
					Stage1 P	Stage2 P

a Assumes design and engineering fees at 32% of construction cost.
b Cost per pound of nitrogen removed per year, in 2006 dollars.
c Cost per pound of phosphorus removed per year, in 2006 dollars.
d Not computable; pollutant removal benefits not defined within NCDENR,

	Stage 1 reduction	Stage 2 Reduction	Total
N	26,534		$207,160,018
P		18,451	$826,838,261
Total Median CostStage1+2			$1,033,998,278

Table C.6. Existing Development Stage 1 Nitrogen Best Cost Estimate

Stage 1 Cost - Based on Nitrogen

County Residential

	BMP Unit Costs										BMP Unit N Load Reduction		Number of BMPs for Full Stage Reduction				Stage 1 Total Costs						
Loading = 2.80 lb/ac/yr	Average Drainage Area (Acres)	BMP Footprint (Acres)	Retrofit Multiplier	Retrofit Installation Cost	Avg Per-Acre Land Cost ($/ac)	BMP Land Cost ($/BMP)	Capital Cost (Install'n + Land)	Annual O&M Cost ($/BMP-Yr)	Planning Costs [35% of Install] ($/BMP)	Reg Trans Costs ($/BMP)	BMP Removal Efficiency	Yearly N Removed (lb)	Projected Proportions of BMPs	Number of BMPs for Stage Reduction	Reduction Achieved by Total # BMPs (lb/yr)	Total Stage I N Load Reduction Need (lb/yr)	Annual O&M Increment	Capital - Installation Cost	BMP footprint-Land Cost	Total Capital (Install + Land)	Local Government Planning Cost	Capital, Land + Planning Costs	Annual O&M @ Full Reduction - 10 Yrs ($/yr)	Cumulative O&M @ 10 yrs
Stormwater Wetland	4.5	0.10	7.0	$55,839	$30,098	$3,115	$58,954	$338	$19,544	$0	40%	0	30%	1,815	0	15,373	$61,422	$101,348,145	$5,654,065	$107,002,210	$35,471,851	$142,474,061	$614,217	$3,071,083
Bioretention	0.9	0.02	2.0	$11,181	$30,098	$736	$11,916	$200	$3,913	$0	35%	0	27%	1,634	0	15,373	$32,709	$18,263,786	$1,201,489	$19,465,275	$6,392,325	$25,857,600	$327,091	$1,635,454
Wet Detention	8.0	0.14	2.3	$129,390	$30,098	$4,154	$133,543	$961	$45,286	$0	25%	0	0%	0	0	15,373	$0	$0	$0	$0	$0	$0	$0	$0
Extended Dry Det.	8.0	0.14	5.0	$117,499	$30,098	$4,154	$121,653	$961	$41,125	$0	10%	0	0%	0	0	15,373	$0	$0	$0	$0	$0	$0	$0	$0
Grassed Swale	1.0	0.01	2.0	$500	$30,098	$345	$845	$205	$175	$0	20%	0	5%	303	0	15,373	$6,209	$151,250	$104,508	$255,758	$52,938	$308,696	$62,087	$310,437
Filter Strip/Level Spreader	2.5	0.29	2.0	$15,150	$30,098	$8,637	$23,787	$236	$5,303	$0	20%	0	0%	0	0	15,373	$0	$0	$0	$0	$0	$0	$0	$0
Infiltration Devices	2.5	0.05	2.0	$17,600	$30,098	$1,568	$19,168	$236	$6,160	$0	30%	0	25%	1,513	0	15,373	$35,683	$26,620,000	$2,371,035	$28,991,035	$9,317,000	$38,308,035	$356,829	$1,784,143
Buffer w/Level Spreader	2.3	0.46	2.0	$713	$30,098	$13,845	$14,558	$233	$250	$0	30%	0	13%	787	0	15,373	$18,321	$560,775	$10,889,311	$11,450,085	$196,271	$11,646,356	$183,214	$916,070
Sand Filter	1.5	0.03	1.0	$60,357	$30,098	$906	$61,263	$794	$21,125	$0	35%	0	0%	0	0	15,373	$0	$0	$0	$0	$0	$0	$0	$0
Total											Enter # **B M P s** to match adj cell to load red need =>			**6,050**	0		$154,344	**$146,943,956**	**$20,220,408**	**$167,164,364**	**$51,430,385**	**$218,594,748**	**$1,543,438**	**$7,717,188**

Municipal Residential

Stage 1

Loading = 7.5 lb/ac/yr	Average Drainage Area (Acres)	BMP Footprint (Acres)	Retrofit Multiplier	Retrofit Installation Cost	Avg Per-Acre Land Cost ($/ac)	BMP Land Cost ($/BMP)	Capital Cost (Install'n + Land)	Annual O&M Cost ($/BMP-Yr)	Planning Costs [35% of Install] ($/BMP)	Reg Trans Costs ($/BMP)	BMP Removal Efficiency	Yearly N Removed (lb)	Projected Proportions of BMPs	Number of BMPs for Stage Reduction	Reduction Achieved by Total # BMPs (lb/yr)	Total Stage I N Load Reduction Need (lb/yr)	Annual O&M Increment	Capital - Installation Cost	BMP footprint-Land Cost	Total Capital (Install + Land)	Local Government Planning Cost	Capital, Land + Planning Costs	Annual O&M @ Full Reduction - 10 Yrs ($/yr)	Cumulative O&M @ 10 yrs
Stormwater Wetland	4.5	0.10	7.0	$55,839	$63,276	$6,549	$62,388	$338	$19,544	$0	40%	0	30%	295	0	6,695	$9,987	$16,478,706	$1,932,695	$18,411,401	$5,767,547	$24,178,948	$99,869	$499,343
Bioretention	0.9	0.02	2.0	$11,181	$63,276	$1,546	$12,727	$200	$3,913	$0	35%	0	27%	266	0	6,695	$5,318	$2,969,601	$410,698	$3,380,299	$1,039,360	$4,419,659	$53,183	$265,917
Wet Detention	8.0	0.14	2.3	$129,390	$63,276	$8,732	$138,122	$961	$45,286	$0	25%	0	0%	0	0	6,695	$0	$0	$0	$0	$0	$0	$0	$0
Extended Dry Det.	8.0	0.14	5.0	$117,499	$63,276	$8,732	$126,231	$961	$41,125	$0	10%	0	0%	0	0	6,695	$0	$0	$0	$0	$0	$0	$0	$0
Grassed Swale	1.0	0.01	2.0	$500	$63,276	$726	$1,226	$205	$175	$0	20%	0	5%	49	0	6,695	$1,010	$24,593	$35,723	$60,316	$8,607	$68,923	$10,095	$50,475
Filter Strip/Level Spreader	2.5	0.29	2.0	$15,150	$63,276	$18,158	$33,308	$236	$5,303	$0	20%	0	0%	0	0	6,695	$0	$0	$0	$0	$0	$0	$0	$0
Infiltration Devices	2.5	0.05	2.0	$17,600	$63,276	$3,296	$20,896	$236	$6,160	$0	30%	0	25%	246	0	6,695	$5,802	$4,328,280	$810,477	$5,138,757	$1,514,898	$6,653,655	$58,019	$290,093
Buffer w/Level Spreader	2.3	0.46	2.0	$713	$63,276	$29,107	$29,820	$233	$250	$0	30%	0	13%	128	0	6,695	$2,979	$91,179	$3,722,227	$3,813,406	$31,913	$3,845,319	$29,790	$148,949
Sand Filter	1.5	0.03	1.0	$60,357	$63,276	$1,905	$62,262	$794	$21,125	$0	35%	0	0%	0	0	6,695	$0	$0	$0	$0	$0	$0	$0	$0
Total											Enter # **B M P s** to match adj cell to load red need =>			**984**	0		$25,096	**$23,892,359**	**$6,911,820**	**$30,804,178**	**$8,362,326**	**$39,166,504**	**$250,955**	**$1,254,776**

Commerical Industrial

Stage 1

Loading = 12.5 lb/ac/yr	Average Drainage Area (Acres)	BMP Footprint (Acres)	Retrofit Multiplier	Retrofit Installation Cost	Avg Per-Acre Land Cost ($/ac)	BMP Land Cost ($/BMP)	Capital Cost (Install'n + Land)	Annual O&M Cost ($/BMP-Yr)	Planning Costs [35% of Install] ($/BMP)	Reg Trans Costs ($/BMP)	BMP Removal Efficiency	Yearly N Removed (lb)	Projected Proportions of BMPs	Number of BMPs for Stage Reduction	Reduction Achieved by Total # BMPs (lb/yr)	Total Stage I N Load Reduction Need (lb/yr)	Annual O&M Increment	Capital - Installation Cost	BMP footprint-Land Cost	Total Capital (Install + Land)	Local Government Planning Cost	Capital, Land + Planning Costs	Annual O&M @ Full Reduction - 10 Yrs ($/yr)	Cumulative O&M @ 10 yrs
Stormwater Wetland	4.5	0.10	7.0	$55,839	$230,029	$23,808	$79,647	$338	$19,544	$0	40%	0	30%	118	0	4,465	$3,996	$6,593,493	$2,811,249	$9,404,741	$2,307,722	$11,712,464	$39,960	$199,798
Bioretention	0.9	0.02	2.0	$11,181	$230,029	$5,621	$16,802	$200	$3,913	$0	35%	0	27%	106	0	4,465	$2,128	$1,188,203	$597,390	$1,785,593	$415,871	$2,201,464	$21,280	$106,399
Wet Detention	8.0	0.14	2.3	$129,390	$230,029	$31,744	$161,134	$961	$45,286	$0	25%	0	0%	0	0	4,465	$0	$0	$0	$0	$0	$0	$0	$0
Extended Dry Det.	8.0	0.14	5.0	$117,499	$230,029	$31,744	$149,243	$961	$41,125	$0	10%	0	0%	0	0	4,465	$0	$0	$0	$0	$0	$0	$0	$0
Grassed Swale	1.0	0.01	2.0	$500	$230,029	$2,640	$3,140	$205	$175	$0	20%	0	5%	20	0	4,465	$404	$9,840	$51,962	$61,802	$3,444	$65,246	$4,039	$20,196
Filter Strip/Level Spreader	2.5	0.29	2.0	$15,150	$230,029	$66,009	$81,159	$236	$5,303	$0	20%	0	0%	0	0	4,465	$0	$0	$0	$0	$0	$0	$0	$0
Infiltration Devices	2.5	0.05	2.0	$17,600	$230,029	$11,981	$29,581	$236	$6,160	$0	30%	0	25%	98	0	4,465	$2,321	$1,731,840	$1,178,899	$2,910,739	$606,144	$3,516,883	$23,215	$116,073
Buffer w/Level Spreader	2.3	0.46	2.0	$713	$230,029	$105,813	$106,526	$233	$250	$0	30%	0	13%	51	0	4,465	$1,192	$36,483	$5,414,257	$5,450,740	$12,769	$5,463,509	$11,920	$59,598
Sand Filter	1.5	0.03	1.0	$60,357	$230,029	$6,925	$67,282	$794	$21,125	$0	35%	0	0%	0	0	4,465	$0	$0	$0	$0	$0	$0	$0	$0
Total											Enter # **B M P s** to match adj cell to load red need =>			**394**	0		$10,041	**$9,559,858**	**$10,053,757**	**$19,613,615**	**$3,345,950**	**$22,959,566**	**$100,413**	**$502,064**

	Number of BMPs for Full Stage I Reduction	**Stage 1 N Reduction**	**Annual O&M Increment**	**Capital - Installation Cost**	**BMP footprint-Land Cost**	**Total Capital (Install + Land)**	**Local Government Planning Cost**	**Capital, Land + Planning Costs**	**Annual O&M @ Full Reduction - 10 Yrs ($/yr)**	**Cumulative O&M @ 10 yrs**
Grand Total	**7,427**	**26,534**	**$189,481**	**$180,396,173**	**$ 37,185,985**	**$217,582,157**	**$ 63,138,660**	**$280,720,818**	**$ 1,894,806**	**$ 9,474,028**
				$ 18,039,617	**$ 3,718,598**	**$ 21,758,216**	**$ 6,313,866**	**$ 28,072,082**	**$ 189,481**	

Table C.7. Summary Stage I & II of Cost, Inflated

Stage I & II Summary of Costs, Inflated

Year	Capital	Planning	O&M	Total
2011	$ 22,142,494	$ 6,425,377	$ 192,827	$ 28,760,698
2012	$ 22,627,552	$ 6,566,133	$ 394,102	$ 29,587,787
2013	$ 23,109,893	$ 6,706,100	$ 603,755	$ 30,419,747
2014	$ 23,566,474	$ 6,838,592	$ 820,911	$ 31,225,977
2015	$ 24,028,141	$ 6,972,560	$ 1,046,241	$ 32,046,941
2016	$ 24,511,917	$ 7,112,944	$ 1,280,766	$ 32,905,627
2017	$ 24,990,113	$ 7,251,708	$ 1,523,378	$ 33,765,199
2018	$ 25,464,638	$ 7,389,407	$ 1,774,062	$ 34,628,107
2019	$ 25,918,934	$ 7,521,236	$ 2,031,426	$ 35,471,596
2020	$ 26,359,024	$ 7,648,943	$ 2,295,465	$ 36,303,432
Total Stg I	**$ 242,719,179**	**$ 70,432,999**	**$ 11,962,933**	**$ 325,115,111**
NPV Stg I	**$ 168,647,075**	**$ 48,938,528**	**$ 7,495,995**	**$ 225,081,599**
2021	$ 78,314,522	$ 21,811,277	$ 2,986,984	$ 103,112,782
2022	$ 79,573,137	$ 22,161,812	$ 3,700,070	$ 105,435,018
2023	$ 80,878,150	$ 22,525,269	$ 4,436,740	$ 107,840,159
2024	$ 82,295,195	$ 22,919,929	$ 5,202,307	$ 110,417,431
2025	$ 83,779,487	$ 23,333,317	$ 5,996,375	$ 113,109,179
2026	$ 85,313,910	$ 23,760,667	$ 6,819,262	$ 115,893,839
2027	$ 86,903,278	$ 24,203,320	$ 7,672,649	$ 118,779,248
2028	$ 88,560,675	$ 24,664,920	$ 8,559,180	$ 121,784,775
2029	$ 90,255,632	$ 25,136,980	$ 9,477,360	$ 124,869,972
2030	$ 91,976,911	$ 25,616,371	$ 10,426,857	$ 128,020,139
2031	$ 93,734,547	$ 26,105,888	$ 11,409,553	$ 131,249,989
2032	$ 95,504,899	$ 26,598,946	$ 12,423,284	$ 134,527,130
2033	$ 97,307,690	$ 27,101,039	$ 13,471,100	$ 137,879,830
2034	$ 99,154,482	$ 27,615,387	$ 14,555,511	$ 141,325,380
2035	$ 101,044,575	$ 28,141,795	$ 15,677,511	$ 144,863,881
Total Stg II	**$ 1,334,597,092**	**$ 371,696,916**	**$ 132,814,742**	**$1,839,108,751**
NPV Stg II	**$ 402,604,671**	**$ 112,128,908**	**$ 35,839,749**	**$ 550,573,328**
Total Stg I+II	**$ 1,577,316,271**	**$ 442,129,915**	**$ 144,777,675**	**$2,164,223,862**
NPV Stg I+II	**$ 571,251,747**	**$ 161,067,436**	**$ 43,335,745**	**$ 775,654,927**

Table C.8. Existing Development Stage 2 Phosphorus Best Cost Estimate

Stage II Cost - Based on Phosphorus

County Residential

Loading = .46 lb/ac/yr	BMP Unit Costs: Average Drainage Area (Acres)	BMP Footprint (Acres)	Retrofit Multiplier	Retrofit Installation Cost	Avg Per-Acre Land Cost ($/ac)	BMP Land Cost ($/BMP)	Capital Cost (Install'n + Land)	O&M Cost ($/BMP-Yr)	Costs [35% of Install] ($/BMP)	Reg Trans Costs ($/BMP)	BMP Unit P Load Reduction: BMP Removal Efficiency	Yearly P Removed (lb)	Number of BMPs for Full Stage Reduction: Projected Propor-tions of BMPs	Number of BMPs for Stage Reduction	Achieved by Total # BMPs (lb/yr)	Stage II P Load Reduction Need	Stage II Total Costs: Annual O&M Increment	Capital - Installation Cost	BMP footprint-Land Cost	Total Capital (Install + Land)	Local Government Planning Cost	Capital, BMP Land + Planning Cost	Annual O&M @ Full Reduction - 15 Yrs ($/yr)	Cumulative O&M @ 15 yrs
Stormwater Wetland	4.5	0.10	7.0	$55,839	$30,098	$3,115	$58,954	$338	$19,544	$0	40%	0.0	30%	6,731	0	10,081	$151,865	$375,875,980	$20,969,572	$396,845,552	$131,556,593	$528,402,145	$2,277,982	$17,084,868
Bioretention	0.9	0.02	2.0	$11,181	$30,098	$736	$11,916	$200	$3,913	$0	45%	0.0	27%	6,058	0	10,081	$80,873	$67,736,006	$4,456,034	$72,192,040	$23,707,602	$95,899,643	$1,213,101	$9,098,260
Wet Detention	8.0	0.14	2.3	$129,390	$30,098	$4,154	$133,543	$961	$45,286	$0	40%	0.0	0%	0	0	10,081	$0	$0	$0	$0	$0	$0	$0	$0
Extended Dry Det.	8.0	0.14	5.0	$117,499	$30,098	$4,154	$121,653	$961	$41,125	$0	10%	0.0	0%	0	0	10,081	$0	$0	$0	$0	$0	$0	$0	$0
Grassed Swale	1.0	0.01	2.0	$500	$30,098	$345	$845	$205	$175	$0	20%	0.0	5%	1,122	0	10,081	$15,351	$560,950	$387,597	$948,547	$196,333	$1,144,879	$230,267	$1,727,002
Filter Strip/Level Spreader	2.5	0.29	2.0	$15,150	$30,098	$8,637	$23,787	$236	$5,303	$0	35%	0.0	0%	0	0	10,081	$0	$0	$0	$0	$0	$0	$0	$0
Infiltration Devices	2.5	0.05	2.0	$17,600	$30,098	$1,568	$19,168	$236	$6,160	$0	35%	0.0	25%	5,610	0	10,081	$88,226	$98,727,200	$8,793,601	$107,520,801	$34,554,520	$142,075,321	$1,323,392	$9,925,441
Buffer w/Level Spreader	2.3	0.46	2.0	$713	$30,098	$13,845	$14,558	$233	$250	$0	35%	0.0	13%	2,917	0	10,081	$45,300	$2,079,778	$40,385,843	$42,465,621	$727,922	$43,193,543	$679,497	$5,096,228
Sand Filter	1.5	0.03	1.0	$60,357	$30,098	$906	$61,263	$794	$21,125	$0	45%	0.0	0%	0	0	10,081	$0	$0	$0	$0	$0	$0	$0	$0
											Enter # BMPs to match adj cell to load red need =>			22,438	0		$381,616	$544,979,915	$74,992,647	$619,972,561	$190,742,970	$810,715,531	$5,724,240	$42,931,799

Municipal Residential

Loading = .9 lb/ac/yr	Average Drainage Area (Acres)	BMP Footprint (Acres)	Retrofit Multiplier	Retrofit Installation Cost	Avg Per-Acre Land Cost ($/ac)	BMP Land Cost ($/BMP)	Capital Cost (Install'n + Land)	O&M Cost ($/BMP-Yr)	Costs [35% of Install] ($/BMP)	Reg Trans Costs ($/BMP)	BMP Removal Efficiency	Yearly P Removed (lb)	Projected Propor-tions of BMPs	Number of BMPs for Stage Reduction	Achieved by Total # BMPs (lb/yr)	Stage II P Load Reduction Need	Annual O&M Increment	Capital - Installation Cost	BMP footprint-Land Cost	Total Capital (Install + Land)	Local Government Planning Cost	Capital, BMP Land + Planning Cost	Annual O&M @ Full Reduction - 15 Yrs ($/yr)	Cumulative O&M @ 15 yrs
Stormwater Wetland	4.5	0.10	7.0	$55,839	$63,276	$6,549	$62,388	$338	$19,544	$0	40%	0.0	30%	1,710	0	5,010	$38,579	$95,485,029	$11,198,903	$106,683,932	$33,419,760	$140,103,692	$578,683	$4,340,126
Bioretention	0.9	0.02	2.0	$11,181	$63,276	$1,546	$12,727	$200	$3,913	$0	45%	0.0	27%	1,539	0	5,010	$20,545	$17,207,204	$2,379,767	$19,586,971	$6,022,521	$25,609,492	$308,168	$2,311,261
Wet Detention	8.0	0.14	2.3	$129,390	$63,276	$8,732	$138,122	$961	$45,286	$0	40%	0.0	0%	0	0	5,010	$0	$0	$0	$0	$0	$0	$0	$0
Extended Dry Det.	8.0	0.14	5.0	$117,499	$63,276	$8,732	$126,231	$961	$41,125	$0	10%	0.0	0%	0	0	5,010	$0	$0	$0	$0	$0	$0	$0	$0
Grassed Swale	1.0	0.01	2.0	$500	$63,276	$726	$1,226	$205	$175	$0	20%	0.0	5%	285	0	5,010	$3,900	$142,500	$206,998	$349,498	$49,875	$399,373	$58,495	$438,716
Filter Strip/Level Spreader	2.5	0.29	2.0	$15,150	$63,276	$18,158	$33,308	$236	$5,303	$0	35%	0.0	0%	0	0	5,010	$0	$0	$0	$0	$0	$0	$0	$0
Infiltration Devices	2.5	0.05	2.0	$17,600	$63,276	$3,296	$20,896	$236	$6,160	$0	35%	0.0	25%	1,425	0	5,010	$22,412	$25,080,000	$4,696,266	$29,776,266	$8,778,000	$38,554,266	$336,186	$2,521,393
Buffer w/Level Spreader	2.3	0.46	2.0	$713	$63,276	$29,107	$29,820	$233	$250	$0	35%	0.0	13%	741	0	5,010	$11,508	$528,333	$21,568,257	$22,096,590	$184,917	$22,281,507	$172,615	$1,294,612
Sand Filter	1.5	0.03	1.0	$60,357	$63,276	$1,905	$62,262	$794	$21,125	$0	45%	0.0	0%	0	0	5,010	$0	$0	$0	$0	$0	$0	$0	$0
											Enter # BMPs to match adj cell to load red need =>			5,700	0		$96,943	$138,443,066	$40,050,191	$178,493,257	$48,455,073	$226,948,330	$1,454,148	$10,906,108

Commercial Industry

Loading = 1.1 lb/ac/yr	Average Drainage Area (Acres)	BMP Footprint (Acres)	Retrofit Multiplier	Retrofit Installation Cost	Avg Per-Acre Land Cost ($/ac)	BMP Land Cost ($/BMP)	Capital Cost (Install'n + Land)	Annual O&M Cost ($/BMP-Yr)	Planning Costs [35% of Install] ($/BMP)	Reg Trans Costs ($/BMP)	BMP Removal Efficiency	Yearly P Removed (lb)	Projected Propor-tions of BMPs	Number of BMPs for Stage Reduction	Reduction Achieved by Total # BMPs (lb/yr)	Total Stage II P Load Reduction Need (lb/yr)	Annual O&M Increment	Capital - Installation Cost	BMP footprint-Land Cost	Total Capital (Install + Land)	Local Government Planning Cost	Capital, BMP Land + Planning Cost	Annual O&M @ Full Reduction - 15 Yrs ($/yr)	Cumulative O&M @ 15 yrs
Stormwater Wetland	4.5	0.10	7.0	$55,839	$230,029	$23,808	$79,647	$338	$19,544	$0	40%	0.0	30%	938	0	3,360	$21,168	$52,391,128	$22,337,857	$74,728,985	$18,336,895	$93,065,880	$317,514	$2,381,359
Bioretention	0.9	0.02	2.0	$11,181	$230,029	$5,621	$16,802	$200	$3,913	$0	45%	0.0	27%	844	0	3,360	$11,272	$9,441,321	$4,746,795	$14,188,116	$3,304,462	$17,492,578	$169,087	$1,268,153
Wet Detention	8.0	0.14	2.3	$129,390	$230,029	$31,744	$161,134	$961	$45,286	$0	40%	0.0	0%	0	0	3,360	$0	$0	$0	$0	$0	$0	$0	$0
Extended Dry Det.	8.0	0.14	5.0	$117,499	$230,029	$31,744	$149,243	$961	$41,125	$0	10%	0.0	0%	0	0	3,360	$0	$0	$0	$0	$0	$0	$0	$0
Grassed Swale	1.0	0.01	2.0	$500	$230,029	$2,640	$3,140	$205	$175	$0	20%	0.0	5%	156	0	3,360	$2,140	$78,188	$412,888	$491,075	$27,366	$518,441	$32,096	$240,717
Filter Strip/Level Spreader	2.5	0.29	2.0	$15,150	$230,029	$66,009	$81,159	$236	$5,303	$0	35%	0.0	0%	0	0	3,360	$0	$0	$0	$0	$0	$0	$0	$0
Infiltration Devices	2.5	0.05	2.0	$17,600	$230,029	$11,981	$29,581	$236	$6,160	$0	35%	0.0	25%	782	0	3,360	$12,297	$13,761,000	$9,367,392	$23,128,392	$4,816,350	$27,944,742	$184,460	$1,383,448
Buffer w/Level Spreader	2.3	0.46	2.0	$713	$230,029	$105,813	$106,526	$233	$250	$0	35%	0.0	13%	407	0	3,360	$6,314	$289,888	$43,021,059	$43,310,947	$101,461	$43,412,407	$94,711	$710,333
Sand Filter	1.5	0.03	1.0	$60,357	$230,029	$6,925	$67,282	$794	$21,125	$0	45%	0.0	0%	0	0	3,360	$0	$0	$0	$0	$0	$0	$0	$0
											Enter # BMPs to match adj cell to load red need =>			3,128	0		$53,191	$75,961,524	$79,885,991	$155,847,515	$26,586,534	$182,434,048	$797,868	$5,984,009

	Total # BMPs	Stage 2 P Reduction	Annual O&M Increment	Capital - Installation Cost	BMP footprint-Land Cost	Total Capital (Install + Land)	Local Government Planning Cost	Capital, BMP Land + Planning Cost	Annual O&M @ Full Reduction - 15 Yrs ($/yr)	Cumulative Stage 2 O&M @ 15 yrs
	31,266	18,451		$759,384,505	$194,928,828	$954,313,333	$265,784,577	$1,220,097,909	$7,976,256	$59,821,917
Grand Total			$531,750	$50,625,634	$12,995,255	$63,620,889	$17,718,972	$81,339,861	$531,750	

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Appendix D: Wastewater Dischargers

Summary of cost equations used in wastewater estimates.

BNR cost estimates for the Falls Lake nutrient strategy are based on information found in the Chesapeake Bay Program's 2002 report entitled "Nutrient Reduction Technology Cost Estimations for Point Sources in the Chesapeake Bay Watershed," prepared by the program's Nutrient Reduction Technology (NRT) Task Force and available for download at http://archive.chesapeakebay.net/pubs/NRT_REPORT_FINAL.pdf. The following is a listing of the particular cost equations used in developing capital and O&M cost estimates for the Falls watershed wastewater dischargers. All results are given in 2000 dollars (ENR CCI = 6400).

Tier 2, TN = 8 mg/L

Capital Cost:

$$\text{Cost} = 2{,}023{,}829 + 704{,}350.8039 \times Q - 5{,}986.733 \times Q^2$$

where Q = design flow rate between 0.5 and 30.0 MGD

$\text{Cost} = 355{,}857 \times \exp(2.4921 \times Q)$ for $1 < Q \leq 0.6$ MGD

O&M Cost (derived from cost data for VA WWTPs in Table X-B)**:**

$\text{Cost} = 12{,}731\ Q_{design} + 40{,}568$ for $0.5 < Q \leq 1.5$ MGD ($R^2 = 0.9981$)

Tier 2, TP = 1 mg/L

Capital Cost – Tier 2, TP = 1 mg/L:

Capital improvements not required – all facilities already have chemical addition and gravity settling capabilities and will only incur operational costs to reach this treatment level.

O&M Cost – Tier 2, TN = 1 mg/L (derived from cost data for VA WWTPs in Table X-B)**:**

$\text{Cost} = 86.881\ Q_{design}^{\ 2} - 194.99\ Q_{design} + 22552$ for $10 < Q \leq 45$ MGD ($R^2 = 0.7309$)

$\text{Cost} = 979.46\ Q_{design} + 7515.6$ for $1.5 < Q \leq 10$ MGD ($R^2 = 0.9689$)

Tier 3, TN = 5 mg/L

Capital Cost:

$\text{Cost} = 967.06\ Q_{design} + 144.44$ for $0.1 < Q \leq 1.0$ MGD

$\text{Cost} = 386.01\ Q_{design} + 864.83$ for $1.0 < Q < 30.0$ MGD

O&M Cost:

$\text{Cost} = 24{,}636\ Q_{design} + 4{,}582.1$ for $0.1 < Q \leq 1.0$ MGD

Cost = 13,383 Q_{design} + 19,021	for 1.0 < Q < 30.0 MGD

Tier 3, TP = 0.5 mg/L

O&M Cost (derived from cost data for VA WWTPs in Table X-B)**:**

Cost = 286.69 Q_{design}^{2} + 1,075.3 Q_{design} + 3680.2	for 1 < Q ≤ 11 MGD (R^2 = 0.986)
Cost = -78.964 Q_{design}^{2} + 7,888.3 Q_{design} - 31310	for 10 < Q ≤ 45 MGD (R^2 = 0.7766)

Tier 4, TN = 3 mg/L

Capital Cost:

Cost = 1,061.7 Q_{design} + 205.83	for 0.1 < Q ≤ 1.0 MGD
Cost = 866.49 Q_{design} + 627.19	for 1.0 < Q < 30.0 MGD

O&M Cost:

Cost = 52,147 Q_{design} + 17,779	for 0.1 < Q ≤ 1.0 MGD
Cost = 26,573 Q_{design} + 44,393	for 1.0 < Q < 30.0 MGD

Tier 4, TP = 0.1 mg/L

Capital Cost (Figure IV-E):

Cost = 1,140,000 $Q_{design}^{0.506}$	for 0.025 < Q ≤ 1.0 MGD
Cost = 1,290,000 $Q_{design}^{0.743}$	for 1.0 < Q < 10.0 MGD
Cost = 739,000 $Q_{design}^{0.941}$	for 10 < Q ≤ 400 MGD

Chemical/ Instrumentation Improvement Cost (Figure IV-F):

Cost = 55,556 Q_{design} + 44,444	for Q ≤ 1.0 MGD
Cost = 16,667 Q_{design} + 83,333	for 1.0 < Q < 10.0 MGD
Cost = 12,500 Q_{design} + 125,500	for 10 < Q ≤ 30 MGD

O&M Cost (Figure IV-G):

Cost = 189,196 $Q_{design}^{0.548}$	for 0.025 < Q ≤ 1.0 MGD
Cost = 192,584 $Q_{design}^{0.7683}$	for 1.0 < Q < 10.0 MGD

$$\text{Cost} = 122{,}457\ Q_{design}^{0.9505} \qquad \text{for } 10 < Q \leq 50 \text{ MGD}$$

Table D.1. Existing Wastewater Treatment Facilities in the Falls Lake Watershed

					Current Nutrient Limits		Stage 1 Allocations - TN		Stage 1 Allocations - TP		Baseline Performance (2006)			
Permit	Owner	Facility	Type	Qpmt (MGD)	TN (2009)	TP (2009)	TN (2016)	Equiv Conc	TP (2016)	Equiv Conc	TN	TN Tier	TP	TP Tier
					equiv mg/L	mg/L	lb/yr	mg/L	lb/yr	mg/L	mg/L		mg/L	
NC0023841	City of Durham	North Durham WRF	Municipal , Large	20.0	5.5	2.0	97,665	3.3	10,631	0.3	3.6	3	0.4	3
NC0026824	South Granville WSA (SGWASA)	SGWASA WWTP	Municipal , Large	**5.5**	3.5	2.0	22,107	3.3	2,406	0.3	6.7	2	1.8	1
NC0026433	Town of Hillsborough	Hillsborough WWTP	Municipal , Large	**3.0**	5.5	2.0	8,914	3.3	970	0.3	11.8	0	1.1	1
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	100% Domestic < 1MGD	**0.25**	NA	2.0	NA	5.5	NA	0.5	25.9	0	1.7	1
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	100% Domestic < 1MGD	**0.1**	NA	2.0	NA	5.5	NA	0.5	22.1	0	1.3	1
				28.85										

Table D.2. Wastewater Discharger Cost Summary

ESTIMATED COSTS - WASTEWATER DISCHARGE REQUIREMENTS

Years 1-5 (2011-2015)*

Permit	Owner	Facility	Plng. TN ($MM)	Plng. TP ($MM)	Constr'n TN ($MM)	Constr'n TP ($MM)	Cap. ($MM)	O&M TN ($MM/yr)	O&M TP ($MM/yr)	TN O&M ($MM)	TP O&M ($MM)	O&M ($MM)	Total ($MM)
			TN_CC1	*TP_CC1*	*TN_CC2*	*TP_CC2*	*CC_1_5*	*TN_OM1*	*TP_OM1*				
NC0023841	City of Durham	North Durham WRF	$ 5,614,410	$ -	$ 18,714,702	$ -	$24,329,112	$ -	$ -	$ -	$ -	$ -	$ 24,329,112
NC0026824	South Granville WSA	SGWASA WWTP	$ 1,686,133	$ -	$ 5,620,443	$ -	$ 7,306,576	$ -	$ -	$ -	$ -	$ -	$ 7,306,576
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ 1,008,844	$ -	$ 3,362,812	$ -	$ 4,371,655	$ -	$ -	$ -	$ -	$ -	$ 4,371,655
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	$ 508,023	$ -	$ 1,693,411	$ -	$ 2,201,435	$ -	$ -	$ -	$ -	$ -	$ 2,201,435
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ 425,216	$ -	$ 1,417,386	$ -	$ 1,842,602	$ -	$ -	$ -	$ -	$ -	$ 1,842,602
			$ 9,242,626	$ -	$ 30,808,753	$ -	$40,051,379	$ -	$ -	$ -	$ -	$ -	$ 40,051,379

Years 6-10 (2016-2020)*

Permit	Owner	Facility	Plng.RO ($MM)	Constr'n RO ($MM)	Cap. ($MM)	O&M TN ($MM/yr)	O&M TP ($MM/yr)	TN O&M ($MM)	TP O&M ($MM)	O&M ($MM)	Total ($MM)
						TN_OM6	*TP_OM6*	*TN_OM_6_10*	*TP_OM_6_10*		
NC0023841	City of Durham	North Durham WRF	$ 54,415,385	$181,384,615	$235,800,000	$ 1,168,608	$ 200,891	$ 5,843,041	$ 1,004,455	$ 6,847,497	$242,647,497
NC0026824	South Granville WSA	SGWASA WWTP	$ 14,964,231	$ 49,880,769	$ 64,845,000	$ 258,160	$ 57,411	$ 1,290,801	$ 287,056	$ 1,577,857	$ 66,422,857
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ 8,162,308	$ 27,207,692	$ 35,370,000	$ 168,154	$ 43,674	$ 840,769	$ 218,371	$ 1,059,139	$ 36,429,139
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	$ -	$ -	$ -	$ 32,532	$ 15,889	$ 162,660	$ 79,445	$ 242,105	$ 242,105
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ -	$ -	$ -	$ 21,918	$ 15,451	$ 109,588	$ 77,255	$ 186,843	$ 186,843
			$ 77,541,923	$258,473,077	$336,015,000	$ 1,649,372	$ 333,316	$ 8,246,858	$ 1,666,581	$ 9,913,440	$345,928,440

Years 11-15 (2021-2025)*

Permit	Owner	Facility	Plng.RO ($MM)	Constr'n RO ($MM)	Cap. ($MM)	O&M TN ($MM/yr)	O&M TP ($MM/yr)	O&M RO ($MM/yr)	O&M ($MM)	Total ($MM)
NC0023841	City of Durham	North Durham WRF	$ 21,766,154	$ 72,553,846	$ 94,320,000	$ 1,168,608	$ 200,891	$ 3,347,050	$ 23,582,747	$ 117,902,747
NC0026824	South Granville WSA	SGWASA WWTP	$ 5,985,692	$ 19,952,308	$ 25,938,000	$ 258,160	$ 57,411	$ 920,439	$ 6,180,050	$ 32,118,050
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ 3,264,923	$ 10,883,077	$ 14,148,000	$ 168,154	$ 43,674	$ 502,058	$ 3,569,427	$ 17,717,427
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	$ -	$ -	$ -	$ 32,532	$ 15,889	$ -	$ 242,105	$ 242,105
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ -	$ -	$ -	$ 21,918	$ 15,451	$ -	$ 186,843	$ 186,843
			$ 31,016,769	$103,389,231	$134,406,000	$ 1,649,372	$ 333,316	$ 4,769,546	$ 33,761,171	$ 168,167,171

Years 16-20 (2026-2030)*

Permit	Owner	Facility	Plng.RO ($MM)	Constr'n RO ($MM)	Cap. ($MM)	O&M TN ($MM/yr)	O&M TP ($MM/yr)	O&M RO ($MM/yr)	O&M ($MM)	Total ($MM)
NC0023841	City of Durham	North Durham WRF	$ 32,649,231	$108,830,769	$141,480,000	$ 1,168,608	$ 200,891	$ 8,367,625	$ 48,685,622	$ 190,165,622
NC0026824	South Granville WSA	SGWASA WWTP	$ 8,978,538	$ 29,928,462	$ 38,907,000	$ 258,160	$ 57,411	$ 2,301,097	$ 13,083,341	$ 51,990,341
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ 4,897,385	$ 16,324,615	$ 21,222,000	$ 168,154	$ 43,674	$ 1,255,144	$ 7,334,858	$ 28,556,858
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	$ -	$ -	$ -	$ 32,532	$ 15,889	$ -	$ 242,105	$ 242,105
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ -	$ -	$ -	$ 21,918	$ 15,451	$ -	$ 186,843	$ 186,843
			$ 46,525,154	$155,083,846	$201,609,000	$ 1,649,372	$ 333,316	$ 11,923,866	$ 69,532,768	$ 271,141,768

Years 21-25 (2031-2035)*

Permit	Owner	Facility	Plng. ($MM)	Constr. ($MM)	Cap. ($MM)	O&M TN ($MM/yr)	O&M TP ($MM/yr)	O&M RO ($MM/yr)	O&M ($MM)	Total ($MM)
NC0023841	City of Durham	North Durham WRF	$ -	$ -	$ -	$ 1,168,608	$ 200,891	$ 16,735,250	$ 90,523,747	$ 90,523,747
NC0026824	South Granville WSA	SGWASA WWTP	$ -	$ -	$ -	$ 258,160	$ 57,411	$ 4,602,194	$ 24,588,825	$ 24,588,825
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ -	$ -	$ -	$ 168,154	$ 43,674	$ 2,510,288	$ 13,610,577	$ 13,610,577
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	$ -	$ -	$ -	$ 32,532	$ 15,889	$ -	$ 242,105	$ 242,105
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ -	$ -	$ -	$ 21,918	$ 15,451	$ -	$ 186,843	$ 186,843
			$ -	$ -	$ -	$ 1,649,372	$ 333,316	$ 23,847,731	$129,152,096	$ 129,152,096

Table D.3 Wastewater Discharger Cost Summary (Adjusted to Inflation and discount Present Value)

Permit	Owner	Facility	2011 Planning	2011 Constr	2011 O&M	2012 Planning	2012 Constr	2012 O&M	2013 Planning	2013 Constr	2013 O&M	2014 Planning	2014 Constr	2014 O&M	2015 Planning	2015 Constr	2015 O&M	Total ($MM)
			Years 1-5 (2011-2015)*															
NC0023841	City of Durham	North Durham WRF	$ -	$ -	$ -	$ 2,807,205	$ -	$ -	$ 2,807,205	$ -	$ -	$ -	$ 9,357,351	$ -	$ -	$ 9,357,351	$ -	$ 24,329,112
NC0026824	South Granville WSA	SGWASA WWTP	$ -	$ -	$ -	$ 843,066	$ -	$ -	$ 843,066	$ -	$ -	$ -	$ 2,810,221	$ -	$ -	$ 2,810,221	$ -	$ 7,306,576
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ -	$ -	$ -	$ 504,422	$ -	$ -	$ 504,422	$ -	$ -	$ -	$ 1,681,406	$ -	$ -	$ 1,681,406	$ -	$ 4,371,655
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	$ -	$ -	$ -	$ 254,012	$ -	$ -	$ 254,012	$ -	$ -	$ -	$ 846,706	$ -	$ -	$ 846,706	$ -	$ 2,201,435
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ -	$ -	$ -	$ 212,608	$ -	$ -	$ 212,608	$ -	$ -	$ -	$ 708,693	$ -	$ -	$ 708,693	$ -	$ 1,842,602
			$ -	$ -	$ -	$ 4,621,313	$ -	$ -	$ 4,621,313	$ -	$ -	$ -	$ 15,404,377	$ -	$ -	$ 15,404,377	$ -	$ 40,051,379
		Estimated annual rate of inflation:	1.018	1.018	1.018	1.040	1.040	1.040	1.062	1.062	1.062	1.083	1.083	1.083	1.104	1.104	1.104	
		Adjusted for inflation:	$ -	$ -	$ -	$ 4,805,955	$ -	$ -	$ 4,908,401	$ -	$ -	$ -	$ 16,684,587	$ -	$ -	$ 17,011,438	$ -	$ 43,410,381
		Discounted to PV:	$ -	$ -	$ -	$ 4,197,707	$ -	$ -	$ 4,006,717	$ -	$ -	$ -	$ 12,728,592	$ -	$ -	$ 12,128,920	$ -	$ 33,061,936

Permit	Owner	Facility	2016 Planning	2016 Constr	2016 O&M	2017 Planning	2017 Constr	2017 O&M	2018 Planning	2018 Constr	2018 O&M	2019 Planning	2019 Constr	2019 O&M	2020 Planning	2020 Constr	2020 O&M	Total ($MM)
			Years 6-10 (2016-2020)*															
NC0023841	City of Durham	North Durham WRF	$ -	$ -	$ 1,369,499	$ -	$ -	$ 1,369,499	$ -	$ -	$ 1,369,499	$ 54,415,385	$ -	$ 1,369,499	$ -	$ 181,384,615	$ 1,369,499	$ 242,647,497
NC0026824	South Granville WSA	SGWASA WWTP	$ -	$ -	$ 315,571	$ -	$ -	$ 315,571	$ -	$ -	$ 315,571	$ 14,964,231	$ -	$ 315,571	$ -	$ 49,880,769	$ 315,571	$ 66,422,857
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ -	$ -	$ 211,828	$ -	$ -	$ 211,828	$ -	$ -	$ 211,828	$ 8,162,308	$ -	$ 211,828	$ -	$ 27,207,692	$ 211,828	$ 36,429,139
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ 242,105
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ 186,843
			$ -	$ -	$ 1,982,688	$ -	$ -	$ 1,982,688	$ -	$ -	$ 1,982,688	$ 77,541,923	$ -	$ 1,982,688	$ -	$ 258,473,077	$ 1,982,688	$ 345,928,440
		Estimated annual rate of inflation:	1.127	1.127	1.127	1.149	1.149	1.149	1.170	1.170	1.170	1.191	1.191	1.191	1.211	1.211	1.211	
		Adjusted for inflation:	$ -	$ -	$ 2,233,615	$ -	$ -	$ 2,277,190	$ -	$ -	$ 2,320,431	$ 92,369,889	$ -	$ 2,361,828	$ -	$ 313,127,607	$ 2,401,930	$ 417,092,491
		Discounted to PV:	$ -	$ -	$ 1,488,352	$ -	$ -	$ 1,418,120	$ -	$ -	$ 1,350,512	$ 50,243,100	$ -	$ 1,284,678	$ -	$ 159,178,198	$ 1,221,020	$ 216,183,978

Permit	Owner	Facility	2021 Planning	2021 Constr	2021 O&M	2022 Planning	2022 Constr	2022 O&M	2023 Planning	2023 Constr	2023 O&M	2024 Planning	2024 Constr	2024 O&M	2025 Planning	2025 Constr	2025 O&M	Total ($MM)
			Years 11-15 (2021-2025)*															
NC0023841	City of Durham	North Durham WRF	$ -	$ -	$ 4,716,549	$ -	$ -	$ 4,716,549	$ -	$ -	$ 4,716,549	$ 21,766,154	$ -	$ 4,716,549	$ -	$ 72,553,846	$ 4,716,549	$ 117,902,747
NC0026824	South Granville WSA	SGWASA WWTP	$ -	$ -	$ 1,236,010	$ -	$ -	$ 1,236,010	$ -	$ -	$ 1,236,010	$ 5,985,692	$ -	$ 1,236,010	$ -	$ 19,952,308	$ 1,236,010	$ 32,118,050
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ -	$ -	$ 713,885	$ -	$ -	$ 713,885	$ -	$ -	$ 713,885	$ 3,264,923	$ -	$ 713,885	$ -	$ 10,883,077	$ 713,885	$ 17,717,427
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ 242,105
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ 186,843
			$ -	$ -	$ 6,752,234	$ -	$ -	$ 6,752,234	$ -	$ -	$ 6,752,234	$ 31,016,769	$ -	$ 6,752,234	$ -	$ 103,389,231	$ 6,752,234	$ 168,167,171
		Estimated annual rate of inflation:	1.231	1.231	1.231	1.251	1.251	1.251	1.271	1.271	1.271	1.294	1.294	1.294	1.317	1.317	1.317	
		Adjusted for inflation:	$ -	$ -	$ 8,311,704	$ -	$ -	$ 8,445,284	$ -	$ -	$ 8,583,788	$ 40,120,959	$ -	$ 8,734,182	$ -	$ 136,148,628	$ 8,891,713	$ 219,236,258
		Discounted to PV:	$ -	$ -	$ 3,948,831	$ -	$ -	$ 3,749,807	$ -	$ -	$ 3,561,967	$ 15,559,600	$ -	$ 3,387,266	$ -	$ 49,346,528	$ 3,222,766	$ 82,776,765

Permit	Owner	Facility	2026 Planning	2026 Constr	2026 O&M	2027 Planning	2027 Constr	2027 O&M	2028 Planning	2028 Constr	2028 O&M	2029 Planning	2029 Constr	2029 O&M	2030 Planning	2030 Constr	2030 O&M	Total ($MM)
			Years 16-20 (2026-2030)*															
NC0023841	City of Durham	North Durham WRF	$ -	$ -	$ 9,737,124	$ -	$ -	$ 9,737,124	$ -	$ -	$ 9,737,124	$ 32,649,231	$ -	$ 9,737,124	$ -	$ 108,830,769	$ 9,737,124	$ 190,165,622
NC0026824	South Granville WSA	SGWASA WWTP	$ -	$ -	$ 2,616,668	$ -	$ -	$ 2,616,668	$ -	$ -	$ 2,616,668	$ 8,978,538	$ -	$ 2,616,668	$ -	$ 29,928,462	$ 2,616,668	$ 51,990,341
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ -	$ -	$ 1,466,972	$ -	$ -	$ 1,466,972	$ -	$ -	$ 1,466,972	$ 4,897,385	$ -	$ 1,466,972	$ -	$ 16,324,615	$ 1,466,972	$ 28,556,858
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ 242,105
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ 186,843
			$ -	$ -	$ 13,906,554	$ -	$ -	$ 13,906,554	$ -	$ -	$ 13,906,554	$ 46,525,154	$ -	$ 13,906,554	$ -	$ 155,083,846	$ 13,906,554	$ 271,141,768
		Estimated annual rate of inflation:	1.341	1.341	1.341	1.366	1.366	1.366	1.392	1.392	1.392	1.419	1.419	1.419	1.446	1.446	1.446	
		Adjusted for inflation:	$ -	$ -	$ 18,648,316	$ -	$ -	$ 18,995,728	$ -	$ -	$ 19,358,010	$ 66,002,806	$ -	$ 19,728,501	$ -	$ 224,205,184	$ 20,104,746	$ 387,043,291
		Discounted to PV:	$ -	$ -	$ 6,316,830	$ -	$ -	$ 6,013,561	$ -	$ -	$ 5,727,337	$ 18,250,326	$ -	$ 5,455,095	$ -	$ 57,938,880	$ 5,195,449	$ 104,897,477

Permit	Owner	Facility	2031 Planning	2031 Constr	2031 O&M	2032 Planning	2032 Constr	2032 O&M	2033 Planning	2033 Constr	2033 O&M	2034 Planning	2034 Constr	2034 O&M	2035 Planning	2035 Constr	2035 O&M	Total ($MM)
			Years 21-25 (2031-2035)*															
NC0023841	City of Durham	North Durham WRF	$ -	$ -	$ 18,104,749	$ -	$ -	$ 18,104,749	$ -	$ -	$ 18,104,749	$ -	$ -	$ 18,104,749	$ -	$ -	$ 18,104,749	$ 90,523,747
NC0026824	South Granville WSA	SGWASA WWTP	$ -	$ -	$ 4,917,765	$ -	$ -	$ 4,917,765	$ -	$ -	$ 4,917,765	$ -	$ -	$ 4,917,765	$ -	$ -	$ 4,917,765	$ 24,588,825
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ -	$ -	$ 2,722,115	$ -	$ -	$ 2,722,115	$ -	$ -	$ 2,722,115	$ -	$ -	$ 2,722,115	$ -	$ -	$ 2,722,115	$ 13,610,577
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision WWTP	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ -	$ -	$ 48,421	$ 242,105
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ -	$ -	$ 37,369	$ 186,843
			$ -	$ -	$ 25,830,419	$ -	$ -	$ 25,830,419	$ -	$ -	$ 25,830,419	$ -	$ -	$ 25,830,419	$ -	$ -	$ 25,830,419	$ 129,152,096
		Estimated annual rate of inflation:	1.473	1.473	1.473	1.501	1.501	1.501	1.529	1.529	1.529	1.559	1.559	1.559	1.588	1.588	1.588	
		Adjusted for inflation:	$ -	$ -	$ 38,056,725	$ -	$ -	$ 38,775,497	$ -	$ -	$ 39,507,440	$ -	$ -	$ 40,257,247	$ -	$ -	$ 41,024,635	$ 197,621,543
		Discounted to PV:	$ -	$ -	$ 9,191,197	$ -	$ -	$ 8,752,140	$ -	$ -	$ 8,333,971	$ -	$ -	$ 7,936,580	$ -	$ -	$ 7,558,755	$ 41,772,644

Table D.4. Wastewater Discharger Cost Summary Totals (Adjusted to Inflation and discount Present Value)

Permit	Owner	Facility	Total	Planning	Constr	Capital	O&M	Total
NC0023841	City of Durham	North Durham WRF	$ 665,568,723	$114,445,180	$ 381,483,932	$ 495,929,112	$ 169,639,611	$ 665,568,723
NC0026824	South Granville WSA	SGWASA WWTP	$ 182,426,648	$ 31,614,594	$ 105,381,981	$ 136,996,576	$ 45,430,073	$ 182,426,648
NC0026433	Town of Hillsborough	Hillsborough WWTP	$ 100,685,656	$ 17,333,459	$ 57,778,196	$ 75,111,655	$ 25,574,000	$ 100,685,656
NC0049662	Aqua North Carolina, Inc.	Hawthorne Subdivision	$ 3,169,853	$ 508,023	$ 1,693,411	$ 2,201,435	$ 968,419	$ 3,169,853
NC0063614	Aqua North Carolina, Inc.	Wildwood Green WWTP	$ 2,589,973	$ 425,216	$ 1,417,386	$ 1,842,602	$ 747,371	$ 2,589,973
			$ 954,440,853	**$164,326,472**	**$ 547,754,907**	**$ 712,081,379**	**$ 242,359,474**	**$ 954,440,853**
	Adjusted for inflation:		**$ 1,264,403,964**	**$208,208,010**	**$ 707,177,444**	**$ 915,385,454**	**$ 349,018,509**	**$ 1,264,403,964**
	Discounted to PV:		**$ 478,692,799**	**$ 92,257,449**	**$ 291,321,117**	**$ 383,578,567**	**$ 95,114,233**	**$ 478,692,799**

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Appendix E: Agriculture

Table E.1. 2006 Crop and Pasture in Falls Lake Watershed, Provided by DSWC

Falls Lake Agriculture Land Numbers Provided by DSWC

2006 Cropland and Pastureland in Falls Lake Watershed

Cropland

County	2006 Acres
Durham	10,834
Franklin	599
Granville	6,279
Orange	14,590
Person	20,372
Wake	2,785
Total	**55,459**

Source: Cropland Acres from 2006 Annual Ag Report to EMC multiplied by % in Falls Watershed

Note: According to DSWC, 99% of all cropland is already buffered

Pastureland

County	2006 Acres	2006 acres excluded	2006 unexcluded acres	2006 % unexcluded
Durham	4500	2250	2,250	50%
Franklin	165	82	83	50%
Granville	3500	2100	1,400	40%
Orange	14000	420	13,580	97%
Person	4500	150	4,350	97%
Wake	2060	1030	1,030	50%
Total	**28,725**	**6,032**	**22,693**	79%

Source: 2007 Ag Census then multiplied by % in Falls Watershed

Table E.2. Conservative Reduction Scenario for Falls Lake Agriculture Rule

Cost Calculations for Falls Agriculture Rule

Falls Lake Fiscal Note

2006 Ag Acres Provided by NC DSWC - Source: Ag Census (Pasture), 2006 Neuse Ag Report to EMC (Cropland)

Land Type	2006 Acres	% Watershed	N Load Rate (lb/ac)	P Load Rate (lb/ac)	Total Load N (lbs)	Total Load P (lbs)
DWQ Calculations						
Pasture	29,225	6%	7	1	204,575	29,225
Cropland	55,459	11%	13	3	720,967	166,377
Total	84,684	17%	--	--	**925,542**	**195,602**
DWQ Calculations						
20% Reduction Need Pasture		Stage I			40,915	
40% Reduction Need Pasture		Stage II			81,830	
20% Reduction Need Cropland		Stage I			144,193	
40% Reduction Need Cropland		Stage II			288,387	
20% Reduction Need Total		Stage I Reduction			185,108	
40% Reduction Need Total		Overall Reduction Need			**370,217**	

Pastureland **Total N Load Reduction Needed (lb N/yr)** 81,830 lbs

Assume Total 40% reduction comes entirely from pasture 370,217 lbs

Pastureland Costs

	Pastureland Capital Costs														
BMP (Units)	**% of Total Reduc**	**Stage I Reduc by 2020 (lb N/yr)**	**Cumulative Load Reduc Need by 2036 (lb N/yr)**	**Reduc Rate (lb N / Unit-Yr)**	**Total Units Needed Through 2020 (LF or Ac)**	**Total Units Needed Through 2036 (LF or Ac)**	**Units BMP Added '06-'08 (LF or Ac)**	**Per-Unit BMP Cap Cost ($/Unit BMP)**	**Total Cap Cost Through 2021 Stage I ($)**	**Total Cap Cost Through 2020 Stage I ($)**	**Cap Cost to Farmer Thru 2021 ($)**	**Total Cap Cost Through 2036 ($)**	**Cap Cost to Farmer Thru 2036 ($)**	**Annual Cap Cost ($)**	**Annual Cap Cost to Farmers ($)**
Stream Protection System (LF)	100%	185,108	370,217	0.16	1,139,830	2,279,660	-	$ 4.67	$ 5,319,206.90	**$ 5,319,207**	**$ 1,329,802**	**$ 10,638,414**	**$2,659,603**	**$425,537**	**$ 106,384**
Total	100%														

Stream Protection System Load Reduc Rate (w/ Excluded 20' Forested Buffer*)	
Pasture Loading Rate (lb/ac-yr)	7
System Reduc Efficiency (%)*	50%
Load Reduc Rate (lb/ac-yr)	3.5
Load Reduc Rate (lb/lf stream-yr)	**0.16**

ACSP Cost Share Rate (75% full)	
Stream Prot Sys ($/LF)	$ 3.50

Pasture Export		**Equivalents to Stream Density Ratio of 2.27 mi / mi^2 Land**	
Pasture 'Runoff' Rate (lb/ac-yr)	4.8	Drainage Area (Ac) / LF Stream	0.0464
Cattle Direct Dep Rate (lb/ac-yr)	2.2	Drainage Area (ft2) / LF Stream	2021
Pasture Total Export Rate (lb/ac-yr)	7		

Load Reduction rate applied to Pasture Stream LF Un buffered	71,107	19%

Table E.3. Conservative Cost to Farmers for Falls Lake Agriculture Rule

Year	Planning	Capital Costs	Reg Transaction	O&M	Pivate Land Owner Opp Cost	Capital Costs To Farmer	State ACSP Opp Cost	Fed EQUIP Opp Cost	Total Cost	Total Cost to Farmer
2011	$90,083	$0	$0	$0	$0	$0	$0	$0	$90,083	$0
2012	$90,083	$0	$0	$0	$0	$0	$0	$0	$90,083	$0
2013	$90,083	$0	$0	$0	$0	$0	$0	$0	$90,083	$0
2014	$90,083	$759,887	$0	$11,398	$4,092	$189,972	$61,584	$508,331	$865,459	$205,462
2015	$90,083	$759,887	$0	$22,797	$8,183	$189,972	$61,584	$508,331	$903,746	$243,748
2016	$44,697	$759,887	$0	$34,195	$12,275	$189,972	$61,584	$508,331	$885,248	$270,636
2017	$44,697	$759,887	$0	$45,593	$16,366	$189,972	$61,584	$508,331	$912,137	$297,524
2018	$44,697	$759,887	$0	$56,992	$20,458	$189,972	$61,584	$508,331	$939,025	$324,412
2019	$44,697	$759,887	$0	$68,390	$24,549	$189,972	$61,584	$508,331	$965,913	$351,301
2020	$44,697	$759,887	$0	$79,788	$28,641	$189,972	$61,584	$508,331	$992,801	$378,189
2021	$44,697	$354,614	$0	$85,107	$32,732	$88,653	$61,584	$204,377	$602,258	$291,600
2022	$44,697	$354,614	$0	$90,427	$36,824	$88,653	$61,584	$204,377	$616,988	$306,330
2023	$44,697	$354,614	$0	$95,746	$40,916	$88,653	$61,584	$204,377	$631,718	$321,060
2024	$44,697	$354,614	$0	$101,065	$45,007	$88,653	$61,584	$204,377	$646,448	$335,790
2025	$44,697	$354,614	$0	$106,384	$49,099	$88,653	$61,584	$204,377	$661,178	$350,520
2026	$44,697	$354,614	$0	$111,703	$53,190	$88,653	$61,584	$204,377	$675,908	$365,250
2027	$44,697	$354,614	$0	$117,023	$57,282	$88,653	$61,584	$204,377	$690,638	$379,980
2028	$44,697	$354,614	$0	$122,342	$61,373	$88,653	$61,584	$204,377	$705,368	$394,710
2029	$44,697	$354,614	$0	$127,661	$65,465	$88,653	$61,584	$204,377	$720,098	$409,440
2030	$44,697	$354,614	$0	$132,980	$69,556	$88,653	$61,584	$204,377	$734,828	$424,170
2031	$44,697	$354,614	$0	$138,299	$73,648	$88,653	$61,584	$204,377	$749,558	$438,900
2032	$44,697	$354,614	$0	$143,619	$77,739	$88,653	$61,584	$204,377	$764,288	$453,630
2033	$44,697	$354,614	$0	$148,938	$81,831	$88,653	$61,584	$204,377	$779,018	$468,360
2034	$44,697	$354,614	$0	$154,257	$85,923	$88,653	$61,584	$204,377	$793,748	$483,090
2035	$44,697	$354,614	$0	$159,576	$90,014	$88,653	$61,584	$204,377	$808,478	$497,820
Stage I + II Raw	**$1,344,361**	**$10,638,414**	$0	**$2,154,280**	**$1,035,162**	**$2,659,603**	**$1,354,841**	**$6,623,970**	**$15,172,217**	**$5,849,046**

Table E.4. Stage I & II Production with Associated Ag Cost Share and New Efficiency Data

Stage I Acres out of Production	1,047	acres
Stage II Acres out of Production	2,093	acres

State Cost Share (Capital) Available in 2009	
Durham	$47,012
Franklin	$61,298
Granville	$62,494
Orange	$64,123
Person	$66,997
Wake	$67,578
Average	**$61,584**

Sate Capital: Assumed Avg State Cost Share Available for each County

Federal Capital: Assume remainder comes from Federal Equip

Methodology

Operation & Maintenance Calculation

O&M = 15% of installation costs, distributed over practice life, per DSWC

All practices used (except NM @ zero capital cost) have 10 yr contract life

Thus, annual o&m = .15* annual cap cost *.1 + previous yr o&m

Opportunity Cost Calculation

Opp Cost = $43/ac-yr = soil rental rate, per DSWC

Cumulative with acres retired

Tar Pasture Point System Excluded Buffer BMP Revisions per 1/07 NLEW Committee Revisions to Buffer Efficiencies

BMP	Old NLEW Eff	Old Pas Pt	New NLEW Eff	New Pas Pt	Exclusion Pt	Total New Exclu'd Buff Credit
20' Filter Strip	40%	27	30%	21	30	51%
20' Forest Buff	75%	51	30%	21	30	51%
30' Herb Buff	65%	45	40%	27	30	57%
50' Combo Buff	85%	58	50%	34	30	64%

Table E.5. Best Reduction Scenario for Falls Lake Agriculture Rule

Cost Calculations for Falls Agriculture Rule

Falls Lake Fiscal Note

2006 Ag Acres Provided by NC DSWC - Source: Ag Census (Pasture), 2006 Neuse Ag Report to EMC (Cropland)

Land Type	2006 Acres	% Watershed	N Load Rate (lb/ac)	P Load Rate (lb/ac)	Total Load N (lbs)	Total Load P (lbs)
DWQ Calculations						
Pasture	29,225	6%	7	1	204,575	29,225
Cropland	55,459	11%	13	3	720,967	166,377
Total	84,684	17%	--	--	**925,542**	**195,602**
DWQ Calculations						
20% Reduction Need Pasture		Stage I			40,915	
40% Reduction Need Pasture		Stage II			81,830	
20% Reduction Need Cropland		Stage I			115,355	
40% Reduction Need Cropland		Stage II			230,709	
20% Reduction Need Total		Stage I Reduction			156,270	
40% Reduction Need Total		Overall Reduction Need			**312,539**	

***Pastureland* Total N Load Reduction Needed (lb N/yr)**	81,830	lbs
Assume Total 40% reduction comes entirely from pasture	312,539	lbs

Pastureland Costs

	Pastureland Capital Costs														
BMP (Units)	**% of Total Reduc**	**Stage I Reduc by 2020 (lb N/yr)**	**Cumulative Load Reduc Need by 2036 (lb N/yr)**	**Reduc Rate (lb N / Unit-Yr)**	**Total Units Needed Through 2020 (LF or Ac)**	**Total Units Needed Through 2036 (LF or Ac)**	**Units BMP Added '06-'08 (LF or Ac)**	**Per-Unit BMP Cap Cost ($/Unit BMP)**	**Total Cap Cost Through 2021 Stage I ($)**	**Total Cap Cost Through 2020 Stage I ($)**	**Cap Cost to Farmer Thru 2021 ($)**	**Total Cap Cost Through 2036 ($)**	**Cap Cost to Farmer Thru 2036 ($)**	**Annual Cap Cost ($)**	**Annual Cap Cost to Farmers ($)**
Stream Protection System (LF)	100%	156,270	312,539	0.16	962,252	1,924,504	-	$ 4.67	$ 4,490,509.20	**$ 4,490,509**	**$ 1,122,627**	**$ 8,981,018**	**$2,245,255**	**$359,241**	**$ 89,810**
Total	100%														

Stream Protection System Load Reduc Rate (w/ Excluded 20' Forested Buffer*)	
Pasture Loading Rate (lb/ac-yr)	7
System Reduc Efficiency (%)*	50%
Load Reduc Rate (lb/ac-yr)	3.5
Load Reduc Rate (lb/lf stream-yr)	**0.16**

ACSP Cost Share Rate (75% full)	
Stream Prot Sys ($/LF)	$ 3.50

Pasture Export	
Pasture 'Runoff' Rate (lb/ac-yr)	4.8
Cattle Direct Dep Rate (lb/ac-yr)	2.2
Pasture Total Export Rate (lb/ac-yr)	7

Equivalents to Stream Density Ratio of 2.27 mi / mi^2 Land	
Drainage Area (Ac) / LF Stre	0.0464
Drainage Area (ft2) / LF Stre	2021

Load Reduction rate applied to Pasture Stream LF Un buffered	71,107	23%

Table E.6. Best Cost to Farmers for Falls Lake Agriculture Rule

Year	Planning	Capital Costs	Reg Transaction	O&M	Pivate Land Owner Opp Cost	Capital Costs To Farmer	State ACSP Opp Cost	Fed EQUIP Opp Cost	Total Cost	Total Cost to Farmer
2011	$90,083	$0	$0	$0	$0	$0	$0	$0	$90,083	$0
2012	$90,083	$0	$0	$0	$0	$0	$0	$0	$90,083	$0
2013	$90,083	$0	$0	$0	$0	$0	$0	$0	$90,083	$0
2014	$90,083	$641,501	$0	$9,623	$3,454	$160,375	$61,584	$419,542	$754,283	$183,074
2015	$90,083	$641,501	$0	$19,245	$6,908	$160,375	$61,584	$419,542	$776,982	$205,774
2016	$44,697	$641,501	$0	$28,868	$10,362	$160,375	$61,584	$419,542	$754,296	$228,473
2017	$44,697	$641,501	$0	$38,490	$13,816	$160,375	$61,584	$419,542	$776,995	$251,172
2018	$44,697	$641,501	$0	$48,113	$17,271	$160,375	$61,584	$419,542	$799,694	$273,871
2019	$44,697	$641,501	$0	$57,735	$20,725	$160,375	$61,584	$419,542	$822,394	$296,570
2020	$44,697	$641,501	$0	$67,358	$24,179	$160,375	$61,584	$419,542	$845,093	$319,269
2021	$44,697	$299,367	$0	$71,848	$27,633	$74,842	$61,584	$162,942	$515,394	$246,171
2022	$44,697	$299,367	$0	$76,339	$31,087	$74,842	$61,584	$162,942	$527,829	$258,606
2023	$44,697	$299,367	$0	$80,829	$34,541	$74,842	$61,584	$162,942	$540,264	$271,041
2024	$44,697	$299,367	$0	$85,320	$37,995	$74,842	$61,584	$162,942	$552,699	$283,476
2025	$44,697	$299,367	$0	$89,810	$41,449	$74,842	$61,584	$162,942	$565,134	$295,912
2026	$44,697	$299,367	$0	$94,301	$44,903	$74,842	$61,584	$162,942	$577,569	$308,347
2027	$44,697	$299,367	$0	$98,791	$48,358	$74,842	$61,584	$162,942	$590,005	$320,782
2028	$44,697	$299,367	$0	$103,282	$51,812	$74,842	$61,584	$162,942	$602,440	$333,217
2029	$44,697	$299,367	$0	$107,772	$55,266	$74,842	$61,584	$162,942	$614,875	$345,652
2030	$44,697	$299,367	$0	$112,263	$58,720	$74,842	$61,584	$162,942	$627,310	$358,087
2031	$44,697	$299,367	$0	$116,753	$62,174	$74,842	$61,584	$162,942	$639,745	$370,522
2032	$44,697	$299,367	$0	$121,244	$65,628	$74,842	$61,584	$162,942	$652,180	$382,957
2033	$44,697	$299,367	$0	$125,734	$69,082	$74,842	$61,584	$162,942	$664,615	$395,393
2034	$44,697	$299,367	$0	$130,225	$72,536	$74,842	$61,584	$162,942	$677,050	$407,828
2035	$44,697	$299,367	$0	$134,715	$75,991	$74,842	$61,584	$162,942	$689,486	$420,263
Stage I + II Raw	**$1,344,361**	**$8,981,018**	$0	**$1,818,656**	**$873,891**	**$2,245,255**	**$1,354,841**	**$5,380,923**	**$13,017,926**	**$4,937,802**

Table E.7. Stage I & II Production with Associated Ag Cost Share and New Efficiency Data

Stage I Acres out of Production	884	acres
Stage II Acres out of Production	1,767	acres

State Cost Share (Capital) Available in 2009	
Durham	$47,012
Franklin	$61,298
Granville	$62,494
Orange	$64,123
Person	$66,997
Wake	$67,578
Average	**$61,584**

Sate Capital: Assumed Avg State Cost Share Available for each County

Federal Capital: Assume remainder comes from Federal Equip

Methodology

Operation & Maintenance Calculation

O&M = 15% of installation costs, distributed over practice life, per DSWC

All practices used (except NM @ zero capital cost) have 10 yr contract life

Thus, annual o&m = .15* annual cap cost *.1 + previous yr o&m

Opportunity Cost Calculation

Opp Cost = $43/ac-yr = soil rental rate, per DSWC

Cumulative with acres retired

Tar Pasture Point System Excluded Buffer BMP Revisions per 1/07 NLEW Committee Revisions to Buffer Efficiencies

BMP	Old NLEW Eff	Old Pas Pt	New NLEW Eff	New Pas Pt	Exclusion Pt	Total New Exclu'd Buff Credit
20' Filter Strip	40%	27	30%	21	30	51%
20' Forest Buff	75%	51	30%	21	30	51%
30' Herb Buff	65%	45	40%	27	30	57%
50' Combo Buff	85%	58	50%	34	30	64%

Table E. 8. Private Cost Associated with Falls Lake Agriculture Rule

Cost Calculations for Falls Agriculture Rule

Falls Lake Fiscal Note

Low Estimate (Assume Ag has already achieved a 20% redcution from cropland)

TOTAL COST TO PRIVATE PARTIES

Inflated Costs Stage I — $ 56,685

Inflation Factor vs 2010 (CPI)	Year	Planning	Capital	Reg Trans	O&M	Opportunity	Total	Total
1.02	2011	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.04	2012	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.06	2013	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.08	2014	$ -	$ 173,205	$ -	$ 10,392	$ 3,730	$ -	$ 187,328
1.10	2015	$ -	$ 176,413	$ -	$ 21,170	$ 7,599	$ -	$ 205,181
1.13	2016	$ -	$ 181,224	$ -	$ 32,620	$ 11,709	$ -	$ 225,554
1.15	2017	$ -	$ 184,432	$ -	$ 44,264	$ 15,889	$ -	$ 244,584
1.17	2018	$ -	$ 187,639	$ -	$ 56,292	$ 20,207	$ -	$ 264,137
1.19	2019	$ -	$ 190,847	$ -	$ 68,705	$ 24,662	$ -	$ 284,214
1.21	2020	$ -	$ 194,054	$ -	$ 81,503	$ 29,256	$ -	$ 304,813
	Total	$ -	$ 1,287,814	$ -	$ 314,945	$ 113,053	$ -	$ 1,715,812
	NPV	$ -	$ 805,192	$ -	$ 183,888	$ 66,009	$ -	$ 1,055,089

Inflated Costs Stage II — $ 432,833

Inflation Factor vs 2010 (CPI)	Year	Planning	Capital	Reg Trans	O&M	Opportunity	Total	Total
1.23	2021	$ -	$ 92,127	$ -	$ 88,442	$ 34,015	$ -	$ 214,584
1.25	2022	$ -	$ 93,608	$ -	$ 95,480	$ 38,882	$ -	$ 227,969
1.27	2023	$ -	$ 95,143	$ -	$ 102,754	$ 43,910	$ -	$ 241,807
1.29	2024	$ -	$ 96,810	$ -	$ 110,363	$ 49,148	$ -	$ 256,321
1.32	2025	$ -	$ 98,556	$ -	$ 118,267	$ 54,583	$ -	$ 271,406
1.34	2026	$ -	$ 100,361	$ -	$ 126,455	$ 60,214	$ -	$ 287,030
1.37	2027	$ -	$ 102,231	$ -	$ 134,944	$ 66,054	$ -	$ 303,229
1.39	2028	$ -	$ 104,180	$ -	$ 143,769	$ 72,122	$ -	$ 320,071
1.42	2029	$ -	$ 106,174	$ -	$ 152,891	$ 78,403	$ -	$ 337,468
1.45	2030	$ -	$ 108,199	$ -	$ 162,298	$ 84,892	$ -	$ 355,389
1.47	2031	$ -	$ 110,267	$ -	$ 172,016	$ 91,603	$ -	$ 373,885
1.50	2032	$ -	$ 112,349	$ -	$ 182,006	$ 98,518	$ -	$ 392,873
1.53	2033	$ -	$ 114,470	$ -	$ 192,310	$ 105,661	$ -	$ 412,440
1.56	2034	$ -	$ 116,643	$ -	$ 202,958	$ 113,049	$ -	$ 432,650
1.59	2035	$ -	$ 118,866	$ -	$ 213,959	$ 120,690	$ -	$ 453,515
	Total	$ -	$ 1,569,982	$ -	$ 2,198,910	$ 1,111,745	$ -	$ 4,880,637
	NPV	$ -	$ 931,668	$ -	$ 1,234,685	$ 605,736	$ -	$ 2,772,088

Total NPV Stage I + Stage II — $ 1,736,860 — $ 1,418,573 — $ 671,745 — $ 3,827,178

High Estimate (Assume Ag has not achieved any prior reduction from cropland)

TOTAL COST TO PRIVATE PARTIES

Inflated Costs Stage I

Inflation Factor vs 2010 (CPI)	Year	Planning	Capital	Reg Trans	O&M	Opportunity	Total	Total
1.02	2011	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.04	2012	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.06	2013	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1.08	2014	$ -	$ 205,169	$ -	$ 12,310	$ 4,419	$ -	$ 221,898
1.10	2015	$ -	$ 208,969	$ -	$ 25,076	$ 9,001	$ -	$ 243,047
1.13	2016	$ -	$ 214,668	$ -	$ 38,640	$ 13,870	$ -	$ 267,179
1.15	2017	$ -	$ 218,467	$ -	$ 52,432	$ 18,821	$ -	$ 289,721
1.17	2018	$ -	$ 222,267	$ -	$ 66,680	$ 23,936	$ -	$ 312,882
1.19	2019	$ -	$ 226,066	$ -	$ 81,384	$ 29,214	$ -	$ 336,664
1.21	2020	$ -	$ 229,866	$ -	$ 96,544	$ 34,655	$ -	$ 361,065
		$ -	$ 1,525,473	$ -	$ 373,066	$ 133,916	$ -	$ 2,032,455
		$ -	$ 953,786	$ -	$ 217,824	$ 78,190	$ -	$ 1,249,800

Inflated Costs Stage II

Inflation Factor vs 2010 (CPI)	Year	Planning	Capital	Reg Trans	O&M	Opportunity	Total	Total
1.23	2021	$ -	$ 109,129	$ -	$ 104,763	$ 40,292	$ -	$ 254,184
1.25	2022	$ -	$ 110,882	$ -	$ 113,100	$ 46,057	$ -	$ 270,039
1.27	2023	$ -	$ 112,701	$ -	$ 121,717	$ 52,014	$ -	$ 286,432
1.29	2024	$ -	$ 114,675	$ -	$ 130,730	$ 58,218	$ -	$ 303,623
1.32	2025	$ -	$ 116,744	$ -	$ 140,092	$ 64,656	$ -	$ 321,492
1.34	2026	$ -	$ 118,882	$ -	$ 149,791	$ 71,327	$ -	$ 340,000
1.37	2027	$ -	$ 121,097	$ -	$ 159,848	$ 78,244	$ -	$ 359,188
1.39	2028	$ -	$ 123,406	$ -	$ 170,300	$ 85,432	$ -	$ 379,139
1.42	2029	$ -	$ 125,768	$ -	$ 181,106	$ 92,872	$ -	$ 399,745
1.45	2030	$ -	$ 128,167	$ -	$ 192,250	$ 100,558	$ -	$ 420,974
1.47	2031	$ -	$ 130,616	$ -	$ 203,761	$ 108,508	$ -	$ 442,884
1.50	2032	$ -	$ 133,083	$ -	$ 215,594	$ 116,699	$ -	$ 465,376
1.53	2033	$ -	$ 135,595	$ -	$ 227,799	$ 125,160	$ -	$ 488,554
1.56	2034	$ -	$ 138,168	$ -	$ 240,413	$ 133,912	$ -	$ 512,493
1.59	2035	$ -	$ 140,802	$ -	$ 253,444	$ 142,963	$ -	$ 537,209
	Total	$ -	$ 1,859,714	$ -	$ 2,604,708	$ 1,316,911	$ -	$ 5,781,332
	NPV	$ -	$ 561,015	$ -	$ 743,481	$ 364,751	$ -	$ 1,669,247

Total NPV Stage I + Stage II — $ 1,514,801 — $ 961,305 — $ 442,942 — $ 2,919,048

Table E. 9. Local Government Cost Associated with Falls Lake Agriculture Rule

Cost Calculations for Falls Agriculture Rule

Falls Lake Fiscal Note

Low Estimate (Assume Ag has already achieved a 20% redcution from cropland)

TOTAL COST TO LOCAL GOVERNMENTS

Inflated Costs Stage I

Inflation Factor vs 2010 (CPI)	Year	Planning	Capital	Reg Trans	O&M	Opportunity	Total	Total
1.02	2011	$ 17,547	$ -	$ -	$ -	$ -	$ -	$ 17,547
1.04	2012	$ 17,891	$ -	$ -	$ -	$ -	$ -	$ 17,891
1.06	2013	$ 18,235	$ -	$ -	$ -	$ -	$ -	$ 18,235
1.08	2014	$ 18,580	$ -	$ -	$ -	$ -	$ -	$ 18,580
1.10	2015	$ 18,924	$ -	$ -	$ -	$ -	$ -	$ 18,924
1.13	2016	$ 9,720	$ -	$ -	$ -	$ -	$ -	$ 9,720
1.15	2017	$ 9,892	$ -	$ -	$ -	$ -	$ -	$ 9,892
1.17	2018	$ 10,064	$ -	$ -	$ -	$ -	$ -	$ 10,064
1.19	2019	$ 10,236	$ -	$ -	$ -	$ -	$ -	$ 10,236
1.21	2020	$ 10,408	$ -	$ -	$ -	$ -	$ -	$ 10,408
	Total	**$ 141,497**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 141,497**
	NPV	**$ 103,931**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 103,931**

Inflated Costs Stage II

Inflation Factor vs 2010 (CPI)	Year	Planning	Capital	Reg Trans	O&M	Opportunity	Total	Total
1.23	2021	$ 10,588	$ -	$ -	$ -	$ -	$ -	$ 10,588
1.25	2022	$ 10,758	$ -	$ -	$ -	$ -	$ -	$ 10,758
1.27	2023	$ 10,935	$ -	$ -	$ -	$ -	$ -	$ 10,935
1.29	2024	$ 11,126	$ -	$ -	$ -	$ -	$ -	$ 11,126
1.32	2025	$ 11,327	$ -	$ -	$ -	$ -	$ -	$ 11,327
1.34	2026	$ 11,535	$ -	$ -	$ -	$ -	$ -	$ 11,535
1.37	2027	$ 11,749	$ -	$ -	$ -	$ -	$ -	$ 11,749
1.39	2028	$ 11,974	$ -	$ -	$ -	$ -	$ -	$ 11,974
1.42	2029	$ 12,203	$ -	$ -	$ -	$ -	$ -	$ 12,203
1.45	2030	$ 12,435	$ -	$ -	$ -	$ -	$ -	$ 12,435
1.47	2031	$ 12,673	$ -	$ -	$ -	$ -	$ -	$ 12,673
1.50	2032	$ 12,912	$ -	$ -	$ -	$ -	$ -	$ 12,912
1.53	2033	$ 13,156	$ -	$ -	$ -	$ -	$ -	$ 13,156
1.56	2034	$ 13,406	$ -	$ -	$ -	$ -	$ -	$ 13,406
1.59	2035	$ 13,661	$ -	$ -	$ -	$ -	$ -	$ 13,661
	Total	**$ 180,439**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 180,439**
	NPV	**$ 107,077**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 107,077**

Total NPV Stage I + Stage II	**$ 211,008**						**$ 211,008**

High Estimate (Assume Ag has not achieved any prior reduction from cropland)

TOTAL COST TO LOCAL GOVERNMENTS

Inflated Costs Stage I

Inflation Factor vs 2010 (CPI)	Year	Planning	Capital	Reg Trans	O&M	Opportunity	Total	Total
1.02	2011	$ 17,547	$ -	$ -	$ -	$ -	$ -	$ 17,547
1.04	2012	$ 17,891	$ -	$ -	$ -	$ -	$ -	$ 17,891
1.06	2013	$ 18,235	$ -	$ -	$ -	$ -	$ -	$ 18,235
1.08	2014	$ 18,580	$ -	$ -	$ -	$ -	$ -	$ 18,580
1.10	2015	$ 18,924	$ -	$ -	$ -	$ -	$ -	$ 18,924
1.13	2016	$ 9,720	$ -	$ -	$ -	$ -	$ -	$ 9,720
1.15	2017	$ 9,892	$ -	$ -	$ -	$ -	$ -	$ 9,892
1.17	2018	$ 10,064	$ -	$ -	$ -	$ -	$ -	$ 10,064
1.19	2019	$ 10,236	$ -	$ -	$ -	$ -	$ -	$ 10,236
1.21	2020	$ 10,408	$ -	$ -	$ -	$ -	$ -	$ 10,408
	Total	**$ 141,497**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 141,497**
	NPV	**$ 103,931**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 103,931**

Inflated Costs Stage II

Inflation Factor vs 2010 (CPI)	Year	Planning	Capital	Reg Trans	O&M	Opportunity	Total	Total
1.23	2021	$ 10,588	$ -	$ -	$ -	$ -	$ -	$ 10,588
1.25	2022	$ 10,758	$ -	$ -	$ -	$ -	$ -	$ 10,758
1.27	2023	$ 10,935	$ -	$ -	$ -	$ -	$ -	$ 10,935
1.29	2024	$ 11,126	$ -	$ -	$ -	$ -	$ -	$ 11,126
1.32	2025	$ 11,327	$ -	$ -	$ -	$ -	$ -	$ 11,327
1.34	2026	$ 11,535	$ -	$ -	$ -	$ -	$ -	$ 11,535
1.37	2027	$ 11,749	$ -	$ -	$ -	$ -	$ -	$ 11,749
1.39	2028	$ 11,974	$ -	$ -	$ -	$ -	$ -	$ 11,974
1.42	2029	$ 12,203	$ -	$ -	$ -	$ -	$ -	$ 12,203
1.45	2030	$ 12,435	$ -	$ -	$ -	$ -	$ -	$ 12,435
1.47	2031	$ 12,673	$ -	$ -	$ -	$ -	$ -	$ 12,673
1.50	2032	$ 12,912	$ -	$ -	$ -	$ -	$ -	$ 12,912
1.53	2033	$ 13,156	$ -	$ -	$ -	$ -	$ -	$ 13,156
1.56	2034	$ 13,406	$ -	$ -	$ -	$ -	$ -	$ 13,406
1.59	2035	$ 13,661	$ -	$ -	$ -	$ -	$ -	$ 13,661
	Total	**$ 180,439**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 180,439**
	NPV	**$ 107,077**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 107,077**

Total NPV Stage I + Stage II	**$ 211,008**						**$ 211,008**

Table E. 10. State Cost Associated with Falls Lake Agriculture Rule

Cost Calculations for Falls Agriculture Rule

Falls Lake Fiscal Note

Low Estimate (Assume Ag has already achieved a 20% redcution from cropland)

TOTAL COST TO STATE PARTIES

Inflated Costs

Stage I

Inflation Factor vs 2010 (CPI)	Year	Staff Opp Cost	ACSP Opp Cost	Reg Trans	O&M	Capital	Total	Total
1.02	2011	$ 9,960	$ -	$ -	$ -	$ -	$ -	$ 9,960
1.04	2012	$ 10,155	$ -	$ -	$ -	$ -	$ -	$ 10,155
1.06	2013	$ 10,350	$ -	$ -	$ -	$ -	$ -	$ 10,350
1.08	2014	$ 10,546	$ 66,510	$ -	$ -	$ -	$ -	$ 77,056
1.10	2015	$ 10,741	$ 67,742	$ -	$ -	$ -	$ -	$ 78,483
1.13	2016	$ 5,128	$ 69,590	$ -	$ -	$ -	$ -	$ 74,718
1.15	2017	$ 5,219	$ 70,821	$ -	$ -	$ -	$ -	$ 76,040
1.17	2018	$ 5,310	$ 72,053	$ -	$ -	$ -	$ -	$ 77,363
1.19	2019	$ 5,400	$ 73,285	$ -	$ -	$ -	$ -	$ 78,685
1.21	2020	$ 5,491	$ 74,516	$ -	$ -	$ -	$ -	$ 80,007
	Total	**$ 78,299**	**$ 494,517**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 572,816**
	NPV	**$ 57,816**	**$ 309,192**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 367,008**

Inflated Costs

Stage II

Inflation Factor vs 2010 (CPI)	Year	Staff Opp Cost	ACSP Opp Cost	Reg Trans	O&M	Capital	Total	Total
1.23	2021	$ 5,586	$ 75,807	$ -	$ -	$ -	$ -	$ 81,393
1.25	2022	$ 5,676	$ 77,025	$ -	$ -	$ -	$ -	$ 82,701
1.27	2023	$ 5,769	$ 78,288	$ -	$ -	$ -	$ -	$ 84,057
1.29	2024	$ 5,870	$ 79,660	$ -	$ -	$ -	$ -	$ 85,530
1.32	2025	$ 5,976	$ 81,097	$ -	$ -	$ -	$ -	$ 87,073
1.34	2026	$ 6,086	$ 82,582	$ -	$ -	$ -	$ -	$ 88,668
1.37	2027	$ 6,199	$ 84,121	$ -	$ -	$ -	$ -	$ 90,319
1.39	2028	$ 6,317	$ 85,725	$ -	$ -	$ -	$ -	$ 92,042
1.42	2029	$ 6,438	$ 87,366	$ -	$ -	$ -	$ -	$ 93,804
1.45	2030	$ 6,561	$ 89,032	$ -	$ -	$ -	$ -	$ 95,592
1.47	2031	$ 6,686	$ 90,733	$ -	$ -	$ -	$ -	$ 97,419
1.50	2032	$ 6,812	$ 92,447	$ -	$ -	$ -	$ -	$ 99,259
1.53	2033	$ 6,941	$ 94,192	$ -	$ -	$ -	$ -	$ 101,133
1.56	2034	$ 7,073	$ 95,979	$ -	$ -	$ -	$ -	$ 103,052
1.59	2035	$ 7,208	$ 97,809	$ -	$ -	$ -	$ -	$ 105,017
	Total	**$ 95,198**	**$ 1,291,862**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,387,059**
	NPV	**$ 56,493**	**$ 766,624**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 823,117**
Total NPV Stage I + Stage II		**$ 114,309**	**$ 1,075,816**					**$ 1,190,125**

High Estimate (Assume Ag has not achieved any prior reduction from cropland)

TOTAL COST TO STATE GOVERNMENT

Inflated Costs Stage I

Inflation Factor vs 2010 (CPI)	Year	Staff Opp Cost	ACSP Opp Cost	Reg Trans	O&M	Capital	Total	Total
1.02	2011	$ 9,960	$ -	$ -	$ -	$ -	$ -	$ 9,960
1.04	2012	$ 10,155	$ -	$ -	$ -	$ -	$ -	$ 10,155
1.06	2013	$ 10,350	$ -	$ -	$ -	$ -	$ -	$ 10,350
1.08	2014	$ 10,546	$ 66,510	$ -	$ -	$ -	$ -	$ 77,056
1.10	2015	$ 10,741	$ 67,742	$ -	$ -	$ -	$ -	$ 78,483
1.13	2016	$ 5,128	$ 69,590	$ -	$ -	$ -	$ -	$ 74,718
1.15	2017	$ 5,219	$ 70,821	$ -	$ -	$ -	$ -	$ 76,040
1.17	2018	$ 5,310	$ 72,053	$ -	$ -	$ -	$ -	$ 77,363
1.19	2019	$ 5,400	$ 73,285	$ -	$ -	$ -	$ -	$ 78,685
1.21	2020	$ 5,491	$ 74,516	$ -	$ -	$ -	$ -	$ 80,007
	Total	**$ 78,299**	**$ 494,517**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 572,816**
	NPV	**$ 57,816**	**$ 309,192**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 367,008**

Inflated Costs Stage II

Inflation Factor vs 2010 (CPI)	Year	Staff Opp Cost	ACSP Opp Cost	Reg Trans	O&M	Capital	Total	Total
1.23	2021	$ 5,586	$ 75,807	$ -	$ -	$ -	$ -	$ 81,393
1.25	2022	$ 5,676	$ 77,025	$ -	$ -	$ -	$ -	$ 82,701
1.27	2023	$ 5,769	$ 78,288	$ -	$ -	$ -	$ -	$ 84,057
1.29	2024	$ 5,870	$ 79,660	$ -	$ -	$ -	$ -	$ 85,530
1.32	2025	$ 5,976	$ 81,097	$ -	$ -	$ -	$ -	$ 87,073
1.34	2026	$ 6,086	$ 82,582	$ -	$ -	$ -	$ -	$ 88,668
1.37	2027	$ 6,199	$ 84,121	$ -	$ -	$ -	$ -	$ 90,319
1.39	2028	$ 6,317	$ 85,725	$ -	$ -	$ -	$ -	$ 92,042
1.42	2029	$ 6,438	$ 87,366	$ -	$ -	$ -	$ -	$ 93,804
1.45	2030	$ 6,561	$ 89,032	$ -	$ -	$ -	$ -	$ 95,592
1.47	2031	$ 6,686	$ 90,733	$ -	$ -	$ -	$ -	$ 97,419
1.50	2032	$ 6,812	$ 92,447	$ -	$ -	$ -	$ -	$ 99,259
1.53	2033	$ 6,941	$ 94,192	$ -	$ -	$ -	$ -	$ 101,133
1.56	2034	$ 7,073	$ 95,979	$ -	$ -	$ -	$ -	$ 103,052
1.59	2035	$ 7,208	$ 97,809	$ -	$ -	$ -	$ -	$ 105,017
	Total	**$ 95,198**	**$ 1,291,862**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,387,059**
	NPV	**$ 28,718**	**$ 389,713**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 418,431**
Total NPV Stage I + Stage II		**$ 86,534**	**$ 698,904**					**$ 785,439**

Table E. 11. Federal Cost Associated with Falls Lake Agriculture Rule

Cost Calculations for Falls Agriculture Rule

Falls Lake Fiscal Note

Low Estimate (Assume Ag has already achieved a 20% redcution from cropland)

TOTAL COST TO FEDERAL PARTIES

Inflated Costs Stage I — $ -

Inflation Factor vs 2010 (CPI)	Year	Planning	QIUIP Opp Cos	Reg Trans	O&M	Capital	Total	Total
1.02	2011	$ 62,949	$ -	$ -	$ -	$ -	$ -	$ 62,949
1.04	2012	$ 64,184	$ -	$ -	$ -	$ -	$ -	$ 64,184
1.06	2013	$ 65,418	$ -	$ -	$ -	$ -	$ -	$ 65,418
1.08	2014	$ 66,652	$ 453,106	$ -	$ -	$ -	$ -	$ 519,758
1.10	2015	$ 67,887	$ 461,497	$ -	$ -	$ -	$ -	$ 529,383
1.13	2016	$ 34,869	$ 474,083	$ -	$ -	$ -	$ -	$ 508,952
1.15	2017	$ 35,486	$ 482,474	$ -	$ -	$ -	$ -	$ 517,960
1.17	2018	$ 36,103	$ 490,865	$ -	$ -	$ -	$ -	$ 526,968
1.19	2019	$ 36,721	$ 499,255	$ -	$ -	$ -	$ -	$ 535,976
1.21	2020	$ 37,338	$ 507,646	$ -	$ -	$ -	$ -	$ 544,984
	Total	**$ 507,607**	**$ 3,368,925**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 3,876,532**
	NPV	**$ 372,844**	**$ 2,106,386**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 2,479,229**

Inflated Costs Stage II — $ -

Inflation Factor vs 2010 (CPI)	Year	Planning	QIUIP Opp Cos	Reg Trans	O&M	Capital	Total	Total
1.23	2021	$ 37,984	$ 200,574	$ -	$ -	$ -	$ -	$ 238,559
1.25	2022	$ 38,595	$ 203,798	$ -	$ -	$ -	$ -	$ 242,392
1.27	2023	$ 39,228	$ 207,140	$ -	$ -	$ -	$ -	$ 246,368
1.29	2024	$ 39,915	$ 210,769	$ -	$ -	$ -	$ -	$ 250,684
1.32	2025	$ 40,635	$ 214,571	$ -	$ -	$ -	$ -	$ 255,206
1.34	2026	$ 41,379	$ 218,501	$ -	$ -	$ -	$ -	$ 259,880
1.37	2027	$ 42,150	$ 222,571	$ -	$ -	$ -	$ -	$ 264,721
1.39	2028	$ 42,954	$ 226,816	$ -	$ -	$ -	$ -	$ 269,770
1.42	2029	$ 43,776	$ 231,157	$ -	$ -	$ -	$ -	$ 274,933
1.45	2030	$ 44,611	$ 235,565	$ -	$ -	$ -	$ -	$ 280,176
1.47	2031	$ 45,463	$ 240,067	$ -	$ -	$ -	$ -	$ 285,530
1.50	2032	$ 46,322	$ 244,601	$ -	$ -	$ -	$ -	$ 290,923
1.53	2033	$ 47,196	$ 249,218	$ -	$ -	$ -	$ -	$ 296,415
1.56	2034	$ 48,092	$ 253,948	$ -	$ -	$ -	$ -	$ 302,040
1.59	2035	$ 49,009	$ 258,789	$ -	$ -	$ -	$ -	$ 307,798
	Total	**$ 647,310**	**$ 3,418,086**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 4,065,395**
	NPV	**$ 384,130**	**$ 2,028,380**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 2,412,510**

Total NPV Stage I + Stage II — **$ 756,974** | **$ 4,134,766** | **$ 4,891,740**

High Estimate (Assume Ag has not achieved any prior reduction from cropland)

TOTAL COST TO FEDERAL PARTIES

Inflated Costs Stage I — $ -

Inflation Factor vs 2010 (CPI)	Year	Planning	QIUIP Opp Cos	Reg Trans	O&M	Capital	Total	Total
1.02	2011	$ 62,949	$ -	$ -	$ -	$ -	$ -	$ 62,949
1.04	2012	$ 64,184	$ -	$ -	$ -	$ -	$ -	$ 64,184
1.06	2013	$ 65,418	$ -	$ -	$ -	$ -	$ -	$ 65,418
1.08	2014	$ 66,652	$ 548,998	$ -	$ -	$ -	$ -	$ 615,650
1.10	2015	$ 67,887	$ 559,164	$ -	$ -	$ -	$ -	$ 627,051
1.13	2016	$ 34,869	$ 574,414	$ -	$ -	$ -	$ -	$ 609,283
1.15	2017	$ 35,486	$ 584,581	$ -	$ -	$ -	$ -	$ 620,067
1.17	2018	$ 36,103	$ 594,748	$ -	$ -	$ -	$ -	$ 630,851
1.19	2019	$ 36,721	$ 604,914	$ -	$ -	$ -	$ -	$ 641,635
1.21	2020	$ 37,338	$ 615,081	$ -	$ -	$ -	$ -	$ 652,419
	Total	**$ 507,607**	**$ 4,081,901**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 4,589,508**
	NPV	**$ 372,844**	**$ 2,552,167**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 2,925,010**

Inflated Costs Stage II — $ -

Inflation Factor vs 2010 (CPI)	Year	Staff Opp Cost	QIUIP Opp Cos	Reg Trans	O&M	Capital	Total	Total
1.23	2021	$ 37,984	$ 251,579	$ -	$ -	$ -	$ -	$ 289,563
1.25	2022	$ 38,595	$ 255,622	$ -	$ -	$ -	$ -	$ 294,217
1.27	2023	$ 39,228	$ 259,814	$ -	$ -	$ -	$ -	$ 299,042
1.29	2024	$ 39,915	$ 264,366	$ -	$ -	$ -	$ -	$ 304,281
1.32	2025	$ 40,635	$ 269,134	$ -	$ -	$ -	$ -	$ 309,769
1.34	2026	$ 41,379	$ 274,064	$ -	$ -	$ -	$ -	$ 315,443
1.37	2027	$ 42,150	$ 279,169	$ -	$ -	$ -	$ -	$ 321,319
1.39	2028	$ 42,954	$ 284,494	$ -	$ -	$ -	$ -	$ 327,448
1.42	2029	$ 43,776	$ 289,939	$ -	$ -	$ -	$ -	$ 333,715
1.45	2030	$ 44,611	$ 295,468	$ -	$ -	$ -	$ -	$ 340,079
1.47	2031	$ 45,463	$ 301,114	$ -	$ -	$ -	$ -	$ 346,578
1.50	2032	$ 46,322	$ 306,801	$ -	$ -	$ -	$ -	$ 353,123
1.53	2033	$ 47,196	$ 312,593	$ -	$ -	$ -	$ -	$ 359,789
1.56	2034	$ 48,092	$ 318,525	$ -	$ -	$ -	$ -	$ 366,617
1.59	2035	$ 49,009	$ 324,597	$ -	$ -	$ -	$ -	$ 373,606
	Total	**$ 647,310**	**$ 4,287,279**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 4,934,589**
	NPV	**$ 195,272**	**$ 1,293,333**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 1,488,606**

Total NPV Stage I + Stage II — **$ 568,116** | **$ 3,845,500** | **$ 4,413,616**

Table E. 12. Planning and Opportunity Cost Associated with Falls Lake Agriculture Rule

Estimated State Opportunity Costs For Planning / Implementing Falls Lake Ag Rule

Year	DSWC	DWQ	Dist Tech	Tech 1	Tech 2	Farmer 1	Farmer 2	Ext. Agent	NRCS	NCDA	State Total	Local Government	Private	Federal Total	TOTAL
2011	$20,765	$5,600	$2,064	$34,407	$23,747	$700	$700	$700	$700	$700	$9,764	$17,203	$1,400	$61,715	**$90,083**
2012	$20,765	$5,600	$2,064	$34,407	$23,747	$700	$700	$700	$700	$700	$9,764	$17,203	$1,400	$61,715	**$90,083**
2013	$20,765	$5,600	$2,064	$34,407	$23,747	$700	$700	$700	$700	$700	$9,764	$17,203	$1,400	$61,715	**$90,083**
2014	$20,765	$5,600	$2,064	$34,407	$23,747	$700	$700	$700	$700	$700	$9,764	$17,203	$1,400	$61,715	**$90,083**
2015	$20,765	$5,600	$2,064	$34,407	$23,747	$700	$700	$700	$700	$700	$9,764	$17,203	$1,400	$61,715	**$90,083**
2016	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2017	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2018	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2019	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2020	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2021	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2022	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2023	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2024	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2025	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2026	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2027	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2028	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2029	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2030	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2031	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2032	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2033	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2034	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
2035	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350	$4,538	$8,602	$700	$30,858	**$44,697**
Total	**$311,481**	**$84,000**	**$24,085**	**$516,098**	**$356,198**	**$10,500**	**$10,500**	**$10,500**	**$10,500**	**$311,481**	**$1,054,812**	**$258,049**	**$21,000**	**$569,530**	**$1,344,361**

Position	DSWC	DWQ	Dist Tech	Tech 1	Tech 2	Farmer 1	Farmer 2	Ext. Agent	NRCS	NCDA
Annual Salary	$69,218	$70,000	$68,813	$68,813	$47,493	$70,000	$70,000	$70,000	$70,000	$70,000
% of Time (yr 1-5)	30%	8%	3%	50%	50%	1%	1%	1%	1%	1%
% of Time (yr 5-25)	15%	4%	1%	25%	25%	0.5%	0.5%	0.5%	0.5%	0.5%
Opportunity Cost (YR 1-5)	$20,765	$5,600	$2,064	$34,407	$23,747	$700	$700	$700	$700	$700
Opportunity Cost (YR 5-25)	$10,383	$2,800	$688	$17,203	$11,873	$350	$350	$350	$350	$350

Table E. 13. Estimated Capital Cost to Local Governments – Meeting RYE N Rates on Land Application Sites in Falls Watershed

Facility	# Fields	# Acres	Avg Annual	Avg Annual Tons	Tons Applied In	Current Cost	Addl. 30%	Addl. 40% Increase
Hillsoborough	32	377	15,000	1.5	580	$202,929	$60,879	$81,172
OWASA	27	388	15,000	1.5	597	$208,848	$62,655	$83,539
Durham	78	1,012	15,000	1.5	1,556	$544,534	$163,360	$217,814
Total	137	1777			2,732	$956,312	$286,893	$382,525

Assumed Current Cost	$350	Per Dry Ton
Estimated Gallons / Ton	9,756	Gallons/Ton
Low-end Scenario	30% Increase Costs	$105
High-end Scenario	40% Increase Cost	$140

Year	Current Costs	Inflated	Additional Costs Low Estimate (30% Increase)	Additional Costs Low Estimate Inflated	Additional Costs Low Estimate (40% Increase)	Additional Costs High Estimate Inflated	Inflation Factors
2011	$0	$0	$0	$0	$0	$0	1.02
2012	$0	$0	$0	$0	$0	$0	1.04
2013	$0	$0	$0	$0	$0	$0	1.06
2014	$956,312	$1,032,816	$286,893	$309,845	$382,525	$413,127	1.08
2015	$956,312	$1,051,943	$286,893	$315,583	$382,525	$420,777	1.10
2016	$956,312	$1,080,632	$286,893	$324,190	$382,525	$432,253	1.13
2017	$956,312	$1,099,758	$286,893	$329,927	$382,525	$439,903	1.15
2018	$956,312	$1,118,884	$286,893	$335,665	$382,525	$447,554	1.17
2019	$956,312	$1,138,011	$286,893	$341,403	$382,525	$455,204	1.19
2020	$956,312	$1,157,137	$286,893	$347,141	$382,525	$462,855	1.21
2021	$956,312	$1,177,177	$286,893	$353,153	$382,525	$470,871	1.23
2022	$956,312	$1,196,096	$286,893	$358,829	$382,525	$478,438	1.25
2023	$956,312	$1,215,712	$286,893	$364,714	$382,525	$486,285	1.27
2024	$956,312	$1,237,013	$286,893	$371,104	$382,525	$494,805	1.29
2025	$956,312	$1,259,324	$286,893	$377,797	$382,525	$503,729	1.32
2026	$956,312	$1,282,388	$286,893	$384,716	$382,525	$512,955	1.34
2027	$956,312	$1,306,279	$286,893	$391,884	$382,525	$522,511	1.37
2028	$956,312	$1,331,192	$286,893	$399,357	$382,525	$532,477	1.39
2029	$956,312	$1,356,669	$286,893	$407,001	$382,525	$542,668	1.42
2030	$956,312	$1,382,542	$286,893	$414,763	$382,525	$553,017	1.45
2031	$956,312	$1,408,962	$286,893	$422,689	$382,525	$563,585	1.47
2032	$956,312	$1,435,573	$286,893	$430,672	$382,525	$574,229	1.50
2033	$956,312	$1,462,672	$286,893	$438,801	$382,525	$585,069	1.53
2034	$956,312	$1,490,431	$286,893	$447,129	$382,525	$596,173	1.56
2035	$956,312	$1,518,842	$286,893	$455,653	$382,525	$607,537	1.59
Stage I NPV		$4,801,329.24		**$1,440,398.77**		**$1,920,531.69**	
Stage II NPV		$6,051,714.84		**$1,815,514.45**		**$2,420,685.94**	
Stage I + II NPV		$10,853,044.07		**$3,255,913.22**		**$4,341,217.63**	

Appendix F: State and Federal Entities

Table F.1. State and Federal Lands in Falls Lake Watershed

Name	Square Miles	Acres	Percentage
Falls Lake Dry Square Miles	752.35	481,503.43	
DOT ROW	17.93	11,475.20	
Federal Lands			
USACE	38.82	24,844.54	
State Lands			
Total	33.24	21,273.34	
Agriculture and Consumer Services			
Food Distribution Warehouse	0.02	12.66	0.00
Plant Industry Site Durham County	0.12	76.01	0.02
Umstead Farm Unit	6.51	4,165.32	0.87
Crime Control and Prevention			
Butner National Guard Armory	0.04	24.36	0.01
Butner Public Safety	0.00	2.46	0.00
Durham National Guard Armory	0.01	5.09	0.00
Highway Partrol Fuel Facility DOT Roxboro DMV	0.00	2.69	0.00
National Guard Training Site	7.78	4,979.46	1.03
Roxboro National Guard Armory	0.01	4.58	0.00
Corrections			
Butner Correctional Institution	0.25	160.72	0.03
Durham Correctional Center	0.03	19.71	0.00
Orange Correctional Center	0.06	35.35	0.01
Roxboro Satellite Training Center	0.00	2.91	0.00
Umstead Correctional Facility	0.06	38.18	0.01
Cultural Resources			
Bennett Place	0.05	30.23	0.01
Duke Homestead	0.07	44.68	0.01
Stagville Center	0.10	66.66	0.01
DENR			
Ecosystem Enhancement Program	0.05	34.03	0.01
Eno River State Park	5.92	3,789.75	0.79
Occoneechee Mountain Natural Area	0.05	31.94	0.01
Butner Falls Game Land	0.11	68.02	0.01
Health and Human Services			
Butner Town Complex	0.03	19.56	0.00
Moter Vehicles			
Durham District Office	0.00	2.58	0.00
Transportation			
Division Engineer Office	0.01	4.29	0.00
Maintenance Unit Roxboro	0.01	7.06	0.00
Maintenance Yard Durham	0.04	25.55	0.01
Maintenance Yard Hillsborough	0.03	20.95	0.00
Maintenance Yard Weigh Station Efland	0.07	43.18	0.01
Parking Lot - Leased	0.00	0.53	0.00
Resident Engineer Camden Ave Durham	0.00	0.83	0.00
Redident Engineer Club Blvd Durham	0.00	0.37	0.00
HR			
John Umstead Hospital	1.89	1,211.20	0.25
Murdoch Center	0.38	240.56	0.05
Juvenile Justice			
C A Dillon School	0.15	95.56	0.02
Training Center	0.00	2.78	0.00
NC			
School of Math and Science	0.04	27.34	0.01
North Carolina Central University			
Chancellors Residence	0.00	1.98	0.00
North Carolina State University			
Cattle Field Laboratory	4.94	3,160.45	0.66
Hill Demostration Forest	3.74	2,391.64	0.50
Organic Sustainable Farm Research Center	0.41	261.26	0.05
Unknown	0.25	160.87	0.03

Notes:

The Land highlighte in Yellow is considered "Developed Land" that factors into the % of all developed land below

Developed lands in Falls Watershed (Per Model)	**Sq. Miles**	**Acres**	
Developed Open Space	61.97	39,660.80	
Developed Low Density	16.11	10,310.40	
Developed Medium Density	5.18	3,315.20	
Developed High Density	1.89	1,209.60	
Total	85.15	54,496.00	
			% of All Developed
NC DOT ROW	17.93	11,475.20	21.1%
Sum of "Developed" State Lands		2,008.11	3.7%
Sum of Buildabel Federal Lands		4,979.46	9.1%
Sum of Developed Federal Lands		770.00	1.4%
Total		18,462.78	33.9%

Table F.2.New Development Cost Calculations for Federal and State Lands in Falls Lake Watershed

Cost Calculations for Falls Lake State & Federal Lands

Falls Lake Fiscal Note

Entitiy	Acres	% Total Dev Ac	% State Land	% Federal
Total Existing D.	54,496	100.0%		
DOT	11,473	21.1%		
State Land (Non DOT)	2,008	3.7%		
Federal Land	770	1.4%		

New Development

Summary of Costs to Affected Parties

Year	Planning	Capital	O&M	Regulatory TC	Total
2011 Low	0	0	0	$0	$0
2012 Low	$1,194,537	$5,193,665	$88,039	$981,417	$7,457,657
2013 Low	$1,240,645	$5,394,136	$179,475	$1,019,299	$7,833,555
2014 Low	$1,286,565	$5,593,790	$274,297	$1,057,027	$8,211,679
2015 Low	$1,333,967	$5,799,885	$372,611	$1,095,971	$8,602,434
2016	$1,383,852	$6,016,780	$474,603	$1,136,957	$9,012,191
2017	$1,434,724	$6,237,961	$580,343	$1,178,752	$9,431,781
2018	$1,486,706	$6,463,974	$689,915	$1,221,460	$9,862,056
2019	$1,538,836	$6,690,627	$803,329	$1,264,290	$10,297,083
2020	$1,591,447	$6,919,372	$920,620	$1,307,514	$10,738,954
NPV Stg I Low	$8,315,611	$36,155,014	$2,682,476	$6,832,008	$53,985,108
NPV Stg I Hi	$14,104,857	$66,395,859	$2,981,415	$18,160,301	$101,642,432
NPV Stg II Low	$9,387,153	$40,813,918	$8,672,466	$7,712,374	$66,585,911
NPV Stg II Hi	$15,922,397	$74,951,573	$9,638,939	$20,500,422	$121,013,331
NPV Stg I+II Low	$17,702,764	$76,968,931	$11,354,941	$14,544,382	$120,571,018
NPV Stg I+II Hi	$30,027,254	$141,347,432	$12,620,354	$38,600,722	$222,595,762

Table F.3. State New Development Best Cost Analysis

New Development
Summary of Costs to State Entities

Year	Planning	Capital	O&M	Regulatory TC	Total
2011 Low	$0	$0	$0	$0	$0
2012 Low	$44,015	$191,370	$3,244	$36,162	$274,790
2013 Low	$45,714	$198,756	$6,613	$37,558	$288,641
2014 Low	$47,406	$206,113	$10,107	$38,948	$302,574
2015 Low	$49,152	$213,707	$13,730	$40,383	$316,972
2016	$50,990	$221,699	$17,488	$41,893	$332,070
2017	$52,865	$229,849	$21,384	$43,433	$347,530
2018	$54,780	$238,176	$25,421	$45,007	$363,385
2019	$56,701	$246,528	$29,600	$46,585	$379,414
2020	$58,640	$254,956	$33,922	$48,178	$395,695
NPV Stg I Low	$306,403	$1,332,194	$98,840	$251,737	$1,989,175
NPV Stg I Hi	$552,883	$2,500,473	$11,870	$724,987	$3,790,213
NPV Stg II Low	$345,886	$1,503,860	$319,552	$284,176	$2,453,474
NPV Stg II Hi	$624,127	$2,822,681	$383,842	$818,408	$4,649,059
NPV Stg I+II Low	$652,289	$2,836,054	$418,393	$535,913	$4,442,649
NPV Stg I+II Hi	$1,177,010	$5,323,154	$502,568	$1,543,395	**$8,546,127**

Table F. 4. Federal New Development Best Cost Analysis

New Development
Summary of Costs to Federal Entities

Year	Planning	Capital	O&M	Regulatory TC	Total
2011 Low	$0	$0	$0	$0	$0
2012 Low	$622	$2,704	$46	$511	$3,883
2013 Low	$646	$2,808	$93	$531	$4,078
2014 Low	$670	$2,912	$143	$550	$4,275
2015 Low	$694	$3,020	$194	$571	$4,479
2016	$720	$3,132	$247	$592	$4,692
2017	$747	$3,248	$302	$614	$4,910
2018	$774	$3,365	$359	$636	$5,134
2019	$801	$3,483	$418	$658	$5,361
2020	$829	$3,602	$479	$681	$5,591
NPV Stg I Low	$4,329	$18,823	$1,397	$3,557	$28,106
NPV Stg I Hi	$7,812	$35,330	$168	$10,244	$53,554
NPV Stg II Low	$4,887	$21,249	$4,515	$4,015	$34,666
NPV Stg II Hi	$8,819	$39,883	$5,423	$11,564	$65,689
NPV Stg I+II Low	$9,217	$40,072	$5,912	$7,572	$62,772
NPV Stg I+II Hi	$16,631	$75,213	$7,101	$21,807	**$120,752**

Table F.5. Existing Development Cost Calculations for Federal and State Lands in Falls Lake Watershed

Cost Calculations for Falls Lake State & Federal Lands

Falls Lake Fiscal Note

Entitiy	Acres	% Total Dev Ac	% State Land	% Federal
Total Existing D.	54,496	100.0%		
DOT	11,473	21.1%		
State Land (Non	2,008	3.7%		
Federal Land	770	1.4%		

Exisitng Development

Summary of Costs to Affected Parties

Year	Planning	Capital	O&M	Regulatory TC	Total
2011	$6,425,377	$22,142,464	$192,827	$0	$28,760,668
2012	$6,566,133	$22,627,552	$394,102	$0	$29,587,787
2013	$6,706,100	$23,109,893	$603,755	$0	$30,419,748
2014	$6,838,592	$23,566,474	$820,911	$0	$31,225,977
2015	$6,972,560	$24,028,141	$1,046,241	$0	$32,046,942
2016	$7,112,944	$24,511,917	$1,280,766	$0	$32,905,627
2017	$7,251,708	$24,990,113	$1,523,378	$0	$33,765,199
2018	$7,398,407	$25,464,638	$1,744,062	$0	$34,628,107
2019	$7,521,236	$25,918,934	$2,031,426	$0	$35,471,596
2020	$7,648,943	$26,359,024	$2,295,465	$0	$36,303,432
NPV Stg I	$48,938,528	$168,647,075	$7,495,995	$0	$225,081,598
NPV Stg II	$112,128,908	$402,604,671	$35,839,749	$0	$550,573,328
NPV Stg I+II	$161,067,436	$571,251,747	$43,335,745	$0	$775,654,928

Table F.6. State Existing Development Best Cost Analysis

New Development
Summary of Costs to State Entities

Year	Planning	Capital	O&M	Regulatory TC	Total
2011 Low	$0	$0	$0	$0	$0
2012 Low	$44,015	$191,370	$3,244	$35,608	$274,237
2013 Low	$45,714	$198,756	$6,613	$36,983	$288,066
2014 Low	$47,406	$206,113	$10,107	$38,352	$301,977
2015 Low	$49,152	$213,707	$13,730	$39,765	$316,353
2016	$50,990	$221,699	$17,488	$41,252	$331,428
2017	$52,865	$229,849	$21,384	$42,768	$346,865
2018	$54,780	$238,176	$25,421	$44,318	$362,695
2019	$56,701	$246,528	$29,600	$45,872	$378,701
2020	$58,640	$254,956	$33,922	$47,440	$394,958
NPV Stg I Low	$306,403	$1,332,194	$98,840	$247,882	$1,985,320
NPV Stg I Hi	$547,327	$2,465,424	$115,164	$721,512	$3,849,428
NPV Stg II Low	$345,886	$1,503,860	$319,552	$279,824	$2,449,122
NPV Stg II Hi	$617,855	$2,783,117	$372,327	$814,486	$4,587,784
NPV Stg I+II Low	$652,289	$2,836,054	$418,393	$527,706	$4,434,442
NPV Stg I+II Hi	$1,165,182	$5,248,541	$487,491	$1,535,998	**$8,437,212**

Table F. 7. Federal Existing Development Best Cost Analysis

New Development
Summary of Costs to Federal Entities

Year	Planning	Capital	O&M	Regulatory TC	Total
2011 Low	$0	$0	$0	$0	$0
2012 Low	$622	$2,704	$46	$503	$3,875
2013 Low	$646	$2,808	$93	$523	$4,070
2014 Low	$670	$2,912	$143	$542	$4,267
2015 Low	$694	$3,020	$194	$562	$4,470
2016	$720	$3,132	$247	$583	$4,683
2017	$747	$3,248	$302	$604	$4,901
2018	$774	$3,365	$359	$626	$5,125
2019	$801	$3,483	$418	$648	$5,351
2020	$829	$3,602	$479	$670	$5,581
NPV Stg I Low	$4,329	$18,823	$1,397	$3,502	$28,052
NPV Stg I Hi	$7,733	$34,835	$1,627	$10,195	$54,390
NPV Stg II Low	$4,887	$21,249	$4,515	$3,954	$34,605
NPV Stg II Hi	$8,730	$39,324	$5,261	$11,508	$64,823
NPV Stg I+II Low	$9,217	$40,072	$5,912	$7,456	$62,656
NPV Stg I+II Hi	$16,463	$74,159	$6,888	$21,703	**$119,213**

Table F.8. New Development Conservative Cost Calculations for Federal and State Lands in Falls Lake Watershed

Cost Calculations for Falls Lake State & Federal Lands

Falls Lake Fiscal Note

Entitiy	Acres	% Total Dev Ac	% State Land	% Federal
Total Existing D.	54,496	100.0%		
DOT	11,473	21.1%		
State Land (Non DOT)	2,008	3.7%		
Federal Land	770	1.4%		

New Development

Summary of Costs to Affected Parties

Year	Planning	Capital	O&M	Regulatory TC	Total
2011 High	0	0	0	$0	$0
2012 High	$2,026,161	$9,537,759	$97,850	$2,608,726	$14,270,496
2013 High	$2,104,370	$9,905,909	$199,476	$2,709,420	$14,919,175
2014 High	$2,182,259	$10,272,559	$304,865	$2,809,705	$15,569,388
2015 High	$2,262,661	$10,651,036	$414,136	$2,913,224	$16,241,057
2016	$2,347,277	$11,049,346	$527,493	$3,022,168	$16,946,284
2017	$2,433,564	$11,455,529	$645,018	$3,133,265	$17,667,376
2018	$2,521,737	$11,870,583	$766,800	$3,246,789	$18,405,909
2019	$2,610,159	$12,286,815	$892,853	$3,360,635	$19,150,462
2020	$2,699,397	$12,706,886	$1,023,216	$3,475,531	$19,905,030
NPV Stg I Low	$8,315,611	$36,155,014	$2,682,476	$6,832,008	$53,985,108
NPV Stg I Hi	$14,104,857	$66,395,859	$2,981,415	$18,160,301	$101,642,432
NPV Stg II Low	$9,387,153	$40,813,918	$8,672,466	$7,712,374	$66,585,911
NPV Stg II Hi	$15,922,397	$74,951,573	$9,638,939	$20,500,422	$121,013,331
NPV Stg I+II Low	$17,702,764	$76,968,931	$11,354,941	$14,544,382	$120,571,018
NPV Stg I+II Hi	$30,027,254	$141,347,432	$12,620,354	$38,600,722	$222,595,762

Table F.9. State New Development Conservative Cost Analysis

New Development
Summary of Costs to State Entities

Year	Planning	Capital	O&M	Regulatory TC	Total
2011 High	$0	$0	$0	$0	$0
2012 High	$78,623	$354,158	$3,780	$103,645	$540,206
2013 High	$81,658	$367,828	$7,705	$107,646	$564,837
2014 Lhigh	$84,681	$381,443	$11,776	$111,630	$589,530
2015 High	$87,801	$395,496	$15,997	$115,743	$615,037
2016	$91,084	$410,287	$20,376	$120,071	$641,818
2017	$94,432	$425,369	$24,915	$124,485	$669,202
2018	$97,854	$440,781	$29,619	$128,996	$697,250
2019	$101,285	$456,236	$34,489	$133,519	$725,529
2020	$104,748	$471,835	$39,524	$138,084	$754,190
NPV Stg I Low	$306,403	$1,332,194	$98,840	$247,882	$1,985,320
NPV Stg I Hi	$547,327	$2,465,424	$115,164	$721,512	$3,849,428
NPV Stg II Low	$345,886	$1,503,860	$319,552	$279,824	$2,449,122
NPV Stg II Hi	$617,855	$2,783,117	$372,327	$814,486	$4,587,784
NPV Stg I+II Low	$652,289	$2,836,054	$418,393	$527,706	$4,434,442
NPV Stg I+II Hi	$1,165,182	$5,248,541	$487,491	$1,535,998	**$8,437,212**

Table F. 10. Federal New Development Conservative Cost Analysis

New Development
Summary of Costs to Federal Entities

Year	Planning	Capital	O&M	Regulatory TC	Total
2011 High	$0	$0	$0	$0	$0
2012 High	$1,111	$5,004	$53	$1,464	$7,633
2013 High	$1,154	$5,197	$109	$1,521	$7,981
2014 High	$1,196	$5,390	$166	$1,577	$8,330
2015 High	$1,241	$5,588	$226	$1,635	$8,690
2016	$1,287	$5,797	$288	$1,697	$9,069
2017	$1,334	$6,010	$352	$1,759	$9,455
2018	$1,383	$6,228	$419	$1,823	$9,852
2019	$1,431	$6,446	$487	$1,887	$10,251
2020	$1,480	$6,667	$558	$1,951	$10,656
NPV Stg I Low	$4,329	$18,823	$1,397	$3,502	$28,052
NPV Stg I Hi	$7,733	$34,835	$1,627	$10,195	$54,390
NPV Stg II Low	$4,887	$21,249	$4,515	$3,954	$34,605
NPV Stg II Hi	$8,730	$39,324	$5,261	$11,508	$64,823
NPV Stg I+II Low	$9,217	$40,072	$5,912	$7,456	$62,656
NPV Stg I+II Hi	$16,463	$74,159	$6,888	$21,703	**$119,213**

Table F.11. Summary Cost of State New Development and Existing Development

Summary of New D & Existing D Costs to State Lands (Low)

	Planning	Capital	O&M	Reg TC	Total
2011	$ -	$ -	$ -	$ -	$ -
2012	$ 44,015	$ 191,370	$ 3,244	$ 35,608	$ 274,237
2013	$ 370,117	$ 198,756	$ 6,613	$ 36,983	$ 612,469
2014	$ 371,809	$ 1,483,743	$ 73,078	$ 38,352	$ 1,966,981
2015	$ 373,556	$ 1,491,337	$ 76,700	$ 39,765	$ 1,981,357
2016	$ 375,394	$ 1,499,329	$ 80,458	$ 41,252	$ 1,543,893
2017	$ 377,268	$ 1,507,479	$ 84,354	$ 42,768	$ 1,591,003
2018	$ 379,184	$ 1,515,806	$ 88,392	$ 44,318	$ 1,638,628
2019	$ 381,104	$ 1,524,158	$ 92,571	$ 45,872	$ 1,685,713
2020	$ 383,043	$ 1,532,586	$ 96,893	$ 47,440	$ 1,732,621
NPV Stg I Low	$ 1,998,349	$ 6,952,828	$ 375,865	$ 247,882	$ 9,574,925
NPV Stg II Low	$ 4,477,471	$ 16,338,530	$ 1,640,130	$ 279,824	$ 22,735,955
NPV Stg I+II Low	$ 6,475,820	$ 23,291,358	$ 2,015,995	$ 527,706	**$ 32,310,880**

Summary of New D & Existing D Costs to State Lands (Low)

	Planning	Capital	O&M	Reg TC	Total
2011	$ -	$ -	$ -	$ -	$ -
2012	$ 40,000	$ 200,000	$ -	$ 40,000	$ 270,000
2013	$ 370,000	$ 200,000	$ 10,000	$ 40,000	$ 610,000
2014	$ 370,000	$ 1,500,000	$ 70,000	$ 40,000	$ 1,970,000
2015	$ 370,000	$ 1,500,000	$ 80,000	$ 40,000	$ 1,980,000
2016	$ 380,000	$ 1,500,000	$ 80,000	$ 40,000	$ 1,540,000
2017	$ 380,000	$ 1,500,000	$ 80,000	$ 40,000	$ 1,590,000
2018	$ 380,000	$ 1,500,000	$ 90,000	$ 40,000	$ 1,640,000
2019	$ 380,000	$ 1,500,000	$ 90,000	$ 50,000	$ 1,690,000
2020	$ 380,000	$ 1,500,000	$ 100,000	$ 50,000	$ 1,730,000
NPV Stg I Low	$ 2,000,000	$ 7,000,000	$ 376,000	$ 248,000	$ 9,600,000
NPV Stg II Low	$ 4,500,000	$ 16,300,000	$ 1,640,000	$ 280,000	$ 22,700,000
NPV Stg I+II Low	$ 6,500,000	$ 23,300,000	$ 2,016,000	$ 528,000	$ 32,300,000

Summary of New D & Existing D Costs to State Lands (High)

	Planning	Capital	O&M	Reg TC	Total
2011	$ -	$ -	$ -	$ -	$ -
2012	$ 78,623	$ 354,158	$ 3,780	$ 103,645	$ 540,206
2013	$ 406,062	$ 367,828	$ 7,705	$ 107,646	$ 889,241
2014	$ 409,084	$ 1,659,073	$ 74,747	$ 111,630	$ 2,254,534
2015	$ 412,204	$ 1,673,126	$ 78,968	$ 115,743	$ 2,280,041
2016	$ 415,487	$ 1,687,917	$ 83,346	$ 120,071	$ 1,854,283
2017	$ 418,836	$ 1,702,999	$ 87,886	$ 124,485	$ 1,913,339
2018	$ 422,257	$ 1,718,411	$ 92,590	$ 128,996	$ 1,973,183
2019	$ 425,688	$ 1,733,867	$ 97,459	$ 133,519	$ 2,032,541
2020	$ 429,151	$ 1,749,465	$ 102,495	$ 138,084	$ 2,091,853
NPV Stg I High	$ 2,239,273	$ 8,086,058	$ 392,189	$ 721,512	$ 11,439,033
NPV Stg II High	$ 4,749,440	$ 17,617,787	$ 1,692,905	$ 814,486	$ 24,874,617
NPV Stg I+II High	$ 6,988,713	$ 25,703,845	$ 2,085,094	$ 1,535,998	**$ 36,313,650**

Summary of New D & Existing D Costs to State Lands (High)

	Planning	Capital	O&M	Reg TC	Total
2011	$ -	$ -	$ -	$ -	$ -
2012	$ 80,000	$ 400,000	$ -	$ 100,000	$ 540,000
2013	$ 410,000	$ 400,000	$ 10,000	$ 110,000	$ 890,000
2014	$ 410,000	$ 1,700,000	$ 70,000	$ 110,000	$ 2,250,000
2015	$ 410,000	$ 1,700,000	$ 80,000	$ 120,000	$ 2,280,000
2016	$ 420,000	$ 1,700,000	$ 80,000	$ 120,000	$ 1,850,000
2017	$ 420,000	$ 1,700,000	$ 90,000	$ 120,000	$ 1,910,000
2018	$ 420,000	$ 1,700,000	$ 90,000	$ 130,000	$ 1,970,000
2019	$ 430,000	$ 1,700,000	$ 100,000	$ 130,000	$ 2,030,000
2020	$ 430,000	$ 1,700,000	$ 100,000	$ 140,000	$ 2,090,000
NPV Stg I High	$ 2,200,000	$ 8,100,000	$ 392,000	$ 700,000	$ 11,400,000
NPV Stg II High	$ 4,700,000	$ 17,600,000	$ 1,700,000	$ 800,000	$ 24,900,000
NPV Stg I+II High	$ 7,000,000	$ 25,700,000	$ 2,100,000	$ 1,500,000	$ 36,300,000

Table F.12. Summary Cost of Federal New Development and Existing Development

Summary of New D & Existing D Costs to Federal Lands (Low)

	Planning	Capital	O&M	Reg TC	Total
2011	$ -	$ -	$ -	$ -	$ -
2012	$ 622	$ 2,704	$ 46	$ 503	$ 3,875
2013	$ 5,230	$ 2,808	$ 93	$ 523	$ 8,654
2014	$ 5,253	$ 20,965	$ 1,033	$ 542	$ 27,792
2015	$ 5,278	$ 21,072	$ 1,084	$ 562	$ 27,996
2016	$ 5,304	$ 21,185	$ 1,137	$ 583	$ 21,814
2017	$ 5,331	$ 21,300	$ 1,192	$ 604	$ 22,480
2018	$ 5,358	$ 21,418	$ 1,249	$ 626	$ 23,153
2019	$ 5,385	$ 21,536	$ 1,308	$ 648	$ 23,818
2020	$ 5,412	$ 21,655	$ 1,369	$ 670	$ 24,481
NPV Stg I Low	$ 28,236	$ 98,240	$ 5,311	$ 3,502	$ 135,289
NPV Stg II Low	$ 63,264	$ 230,855	$ 23,174	$ 3,954	$ 321,247
NPV Stg I+II Low	$ 91,500	$ 329,095	$ 28,485	$ 7,456	**$ 456,536**

Summary of New D & Existing D Costs to Federal Lands (Low)

	Planning	Capital	O&M	Reg TC	Total
2011	$ -	$ -	$ -	$ -	$ -
2012	$ 1,000	$ 3,000	$ -	$ 1,000	$ 4,000
2013	$ 5,000	$ 3,000	$ -	$ 1,000	$ 9,000
2014	$ 5,000	$ 21,000	$ 1,000	$ 1,000	$ 28,000
2015	$ 5,000	$ 21,000	$ 1,000	$ 1,000	$ 28,000
2016	$ 5,000	$ 21,000	$ 1,000	$ 1,000	$ 22,000
2017	$ 5,000	$ 21,000	$ 1,000	$ 1,000	$ 22,000
2018	$ 5,000	$ 21,000	$ 1,000	$ 1,000	$ 23,000
2019	$ 5,000	$ 22,000	$ 1,000	$ 1,000	$ 24,000
2020	$ 5,000	$ 22,000	$ 1,000	$ 1,000	$ 24,000
NPV Stg I Low	$ 28,000	$ 100,000	$ 5,000	$ 4,000	$ 140,000
NPV Stg II Low	$ 60,000	$ 230,000	$ 23,000	$ 4,000	$ 320,000
NPV Stg I+II Low	$ 90,000	$ 330,000	$ 28,000	$ 7,000	$ 460,000

Summary of New D & Existing D Costs to Federal Lands (High)

	Planning	Capital	O&M	Reg TC	Total
2011	$ -	$ -	$ -	$ -	$ -
2012	$ 1,111	$ 5,004	$ 53	$ 1,464	$ 7,633
2013	$ 5,737	$ 5,197	$ 109	$ 1,521	$ 12,565
2014	$ 5,780	$ 23,442	$ 1,056	$ 1,577	$ 31,855
2015	$ 5,824	$ 23,640	$ 1,116	$ 1,635	$ 32,216
2016	$ 5,871	$ 23,849	$ 1,178	$ 1,697	$ 26,200
2017	$ 5,918	$ 24,062	$ 1,242	$ 1,759	$ 27,034
2018	$ 5,966	$ 24,280	$ 1,308	$ 1,823	$ 27,880
2019	$ 6,015	$ 24,499	$ 1,377	$ 1,887	$ 28,719
2020	$ 6,064	$ 24,719	$ 1,448	$ 1,951	$ 29,557
NPV Stg I High	$ 31,640	$ 114,252	$ 5,541	$ 10,195	$ 161,628
NPV Stg II High	$ 67,107	$ 248,930	$ 23,920	$ 11,508	$ 351,465
NPV Stg I+II High	$ 98,747	$ 363,182	$ 29,461	$ 21,703	**$ 513,093**

Summary of New D & Existing D Costs to Federal Lands (High)

	Planning	Capital	O&M	Reg TC	Total
2011	$ -	$ -	$ -	$ -	$ -
2012	$ 1,000	$ 5,000	$ -	$ 1,000	$ 8,000
2013	$ 6,000	$ 5,000	$ -	$ 2,000	$ 13,000
2014	$ 6,000	$ 23,000	$ 1,000	$ 2,000	$ 32,000
2015	$ 6,000	$ 24,000	$ 1,000	$ 2,000	$ 32,000
2016	$ 6,000	$ 24,000	$ 1,000	$ 2,000	$ 26,000
2017	$ 6,000	$ 24,000	$ 1,000	$ 2,000	$ 27,000
2018	$ 6,000	$ 24,000	$ 1,000	$ 2,000	$ 28,000
2019	$ 6,000	$ 24,000	$ 1,000	$ 2,000	$ 29,000
2020	$ 6,000	$ 25,000	$ 1,000	$ 2,000	$ 30,000
NPV Stg I High	$ 32,000	$ 114,000	$ 6,000	$ 10,000	$ 160,000
NPV Stg II High	$ 67,000	$ 249,000	$ 24,000	$ 12,000	$ 350,000
NPV Stg I+II High	$ 99,000	$ 363,000	$ 29,000	$ 22,000	$ 510,000

Table F.13. NC DOT Input Data (area, loading rates, and reductions)

Falls Lake Background Information:	**Square Meters**	**Acres**
NCDOT Area in Fall Lake:	46,431,132	11473.4
Entire Falls Lake Watershed:	1,938,690,609	479060.9
NCDOT as a % of Total Falls Watershed	2.4%	
Fraction Impervious area within NCDOT Area:	41.6%	
TN loading rate =	3.2	lb TN/ac/yr
TP loading rate =	0.53	lb TP/ac/yr
NCDOT's annual TN load =	36371	lb TN/yr
NCDOT's annual TP load =	6081	lb TP/yr
40% reduction in TN =	14548	lb TN/yr
77% reduction in TP =	4682	lb TP/yr

Table F.14. NC DOT Cost Estimates using Best and Conservative Figures for BMP Implementation

Inflated Costs

[redacted]	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Summary First 5 years**	**NPV**
Date	2011	2012	2013	2014	2015	2011-2015	2011-2015
Number of new non-road projects (estimated)	0	0	0	1	2		
Low cost estimate assuming 2 BMPs per project	$0	$0	$0	$121,739	$247,986	$369,725	**$269,685**
High cost estimate assuming 2 BMPs per project	$0	$0	$0	$179,244	$365,127	$544,371	**$397,075**
Consumer Price Index (CPI Inflation Factor)	1.02	1.04	1.06	1.08	1.10		

Table F.15. NC DOT Planning Cost Estimates for Falls Lake Rule Implementation

	Year 1		Year 2	Year 3	Year 4	Year 5	Summary to Year 5	Summary to Year 2036 **
Program Administration								
Low Range	**$0**	**$0**	**$0**	**$0**	**0**	**0**	**0**	**0**
High Range	**$210,000**	**$0**	**$210,000**	**$210,000**	**210,000**	**210,000**	**1,050,000**	**5,250,000**

* FTE = full time equivalent personnel @ $70,000/person-yr fully burdened salary

* * Cost does not include the implementation of other load reducing measures, e.g. street sweeping, paving gravel roads to reduce phosphorus attached sediment loads, alternatives to fertilizer application, etc, which may be necessary to achieve the ultimate goal and for which nutrient removal credit has yet to be established.

Table F. 16. NC DOT Sensitivity Analysis- Projecting 3 Projects Every 5 years, Inflation Included

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Stage I NPV	Stage II NPV	Stage I + II NPV
Date	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	--	--	--
Number of new non-road projects (estimated)	0	0	0	1	2	0	0	0	1	2	0	0	0	1	2	0	0	0	1	2	0	0	0	1	2	--	--	--
Low cost estimate assuming 2 BMPs per project	$0	$0	$0	$121,739	$247,986	$0	$0	$0	$134,138	$272,785	$0	$0	$0	$145,410	$327,342	$0	$0	$0	$160,064	$359,580	$0	$0	$0	$175,845	$394,298	**$481,317**	**$419,534**	**$900,851**
High cost estimate assuming 2 BMPs per project	$0	$0	$0	$179,244	$365,127	$0	$0	$0	$197,500	$441,803	$0	$0	$0	$214,097	$481,967	$0	$0	$0	$235,673	$529,434	$0	$0	$0	$258,908	$580,551	**$729,092**	**$617,708**	**$1,346,800**
Consumer Price Index (CPI Inflation Factor)	1.02	1.04	1.06	1.08	1.10	1.13	1.15	1.17	1.19	1.21	1.23	1.25	1.27	1.29	1.32	1.34	1.37	1.39	1.42	1.45	1.47	1.50	1.53	1.56	1.59			
Stage II NPV Place Holder	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0																		

Table F.17. NC DOT Best Cost Data Input Chart

	NCDOT Export Rate lbs/ac/year	TMDL Export Rate Target lbs/ac/year	Sum of SW Control Nutrient Removed (lbs/year)
Total Nitrogen	3.17	2.1	14.58
Total Phosphorus	0.53	0.3	2.61

User Input	Known Input	Calculated Output

Stormwater Control	TN Removal Rate	TP Removal Rate	Projected Number of Stormwater Controls	Average Drainage Area (acres)	TN Mass Removed (lbs/year)	TP Mass Removed (lbs/year)	Information Used to Develop Weighted Cost Analysis: TN Removal x Number of SW Controls	TP Removal x Number of SW Controls	Number of SW Controls x Average Drainage Area
Stormwater Wetland	40%	40%	1	4	5.07	0.85	0.4	0.4	4
Bioretention Basin	40%	45%	1	2	2.54	0.48	0.4	0.45	2
Wet Detention Basin	40%	40%	1	3	3.80	0.64	0.4	0.4	3
Sand Filter	35%	45%		0.5	0.00	0.00	0	0	0
Filter Strip	20%	35%	1	1.5	0.95	0.28	0.2	0.35	1.5
Grassed Swale	20%	20%	1	1.5	0.95	0.16	0.2	0.2	1.5
Restored Buffer	30%	35%		3	0.00	0.00	0	0	0
Infiltration Basin	30%	35%		2	0.00	0.00	0	0	0
Dry Detention Basin	10%	10%	1	4	1.27	0.21	0.1	0.1	4
Sum			6		14.6	2.6	1.7	1.9	16

Stormwater Control	Design/ Engineering Cost ($ per acre drainage area)	Construction Cost ($ per acre drainage area)	Design/ Engineering/ Construction Cost (per SW Control)	Annual Cost for Design, Engineering, and Construction	Frequent Maintenance Cost (routine and annual inspection)	Infrequent Maintenance Cost (assumed once every 5 years)	Year 4 Total Cost	Five-Year Total Cost	22-yr construction cost w/ maint. (2036) Total Cost
Stormwater Wetland	$ 8,000	$ 18,750	$ 107,000	$ 107,000	$ 537	$ 7,000	$ 107,537	$ 215,611	$ 2,858,043
Bioretention Basin	$ 13,000	$ 35,500	$ 97,000	$ 97,000	$ 591	$ 2,900	$ 97,591	$ 195,773	$ 2,467,749
Wet Detention Basin	$ 3,000	$ 8,000	$ 33,000	$ 33,000	$ 537	$ 7,000	$ 33,537	$ 67,611	$ 1,230,043
Sand Filter	$ 10,000	$ 38,000	$ 24,000	$ -	$ 250	$ 1,000	$ -	$ -	$ -
Filter Strip	$ 8,000	$ 11,333	$ 29,000	$ 29,000	$ 711	$ 1,000	$ 29,711	$ 60,133	$ 925,029
Grassed Swale	$ 2,000	$ 8,000	$ 15,000	$ 15,000	$ 250	$ 500	$ 15,250	$ 30,750	$ 437,750
Restored Buffer	$ 8,000	$ 15,000	$ 69,000	$ -	$ 250	$ 500	$ -	$ -	$ -
Infiltration Basin	$ 4,000	$ 17,000	$ 42,000	$ -	$ 250	$ 5,500	$ -	$ -	$ -
Dry Detention Basin	$ 3,000	$ 10,500	$ 54,000	$ 54,000	$ 537	$ 5,500	$ 54,537	$ 109,611	$ 1,623,043
Sum			$ 470,000	$ 335,000	$ 3,913	$ 30,900	$ 338,163	$ 679,489	$ 9,541,657

Average-Weighted Cost per SW Control	$ 56,361	$ 22,650	$ 72,285

Average-Weighted TN Removal Rate	28%
Average-Weighted TP Removal Rate	32%
Average-Weighted Drainage (acres)	2.7

Notes:

1. See the '$Range' tab for the origin of and information pertaining to Design/Engineering and Construction Costs listed in columns C and D.
2. Design/engineering/construction cost (per SW Control) is the capital cost per acre times the average drainage area in acres for each BMP type.
3. Wet Detention Basin construction costs derived from WERF model because BSP costs were unavailable.
4. Level spreader cost used for filter strip.
5. The Annual Cost for Design, Engineering, and Construction is the capital cost for the average drainage area of each BMP times the project number of stormwater controls for each BMP.
6. All maintenance costs are provided as a lump sum, per-BMP cost (not per-drainage area)
7. Routine maintenance costs are based on data provided by NCDOT Div 2 and 4. Where maintenance costs were not available for certain BMPs, costs from a similar BMP was applied.
8. Routine maintenance cost includes an additional $100 for annual inspections, which is a conservative estimate based on NCDOT provided information.
9. Infrequent maintenance costs are based on applicable WERF models and applied between similar BMPs where WERF model costs were unavailable.
10. The Annual Cost for Frequent Maintenance is the frequent maintenance cost times the project number of stormwater controls for each BMP.
11. The 5-year Cost for Infrequent Maintenance is the maintenance cost times the project number of stormwater controls for each BMP.
12. Existing nutrient loads from NCDOT ROW are assumed to remain constant. Changes in nutrient depostion to the ROW (eg atmostpheric) are not considered in this analysis.
13. Construction cost for the Restored Buffer derived from the inverse of the BSP regression for design vs construction costs for $24,000 design cost.
14. Discount and inflation rates as well as land aquistion costs are not included in any of the costs provided.
15. Although the costs are presented as $/acre, it may not be appropriate to apply them to acreage other than the average drainage area listed since some costs were based on average construction costs and not correlated to drainage area except for the purposes of this application.

Table F.18. NC DOT Best Cost Total Analysis Summary

Date			Loading Analysis				Cost Analysis to achieve flat rate BMP implementation requirements					Inflated Cost Anal
			Number of Stormwater Controls Built	NCDOT Area Treated by SW Controls (acres)	Total Nitrogen Load Reduction (pounds)	Total Phosphorus Load Reduction	Captial: Design, Engineering, and Construction Costs	Operation & Maintenance: (routine, annual, and life-cycle	Planning / Opportunity Cost (Assumes Equivalent of 1 Staff	Total cost to comply with BMP implementation rate requirements		Captial: Design, Engineering, and Construction Costs
Year 1	2011	Stormwater Management Program Development					$ -	$ -	$ -	$ -		$ -
Year 2	2012						$ -	$ -	$ -	$ -		$ -
Year 3	2013						$ -	$ -	$ 70,000	$ 70,000		$ -
Year 4	2014		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 361,800
Year 5	2015		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 368,500
Year 6	2016		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 378,550
Year 7	2017		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 385,250
Year 8	2018		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 391,950
Year 9	2019		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 398,650
Year 10	2020		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 405,350
Year 11	2021		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 412,050
Year 12	2022		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 418,750
Year 13	2023		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 425,450
Year 14	2024		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 432,150
Year 15	2025		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 442,200
Year 16	2026		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 448,900
Year 17	2027		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 458,950
Year 18	2028		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 465,650
Year 19	2029		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 475,700
Year 20	2030		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 485,750
Year 21	2031		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 492,450
Year 22	2032		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 502,500
Year 23	2033		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 512,550
Year 24	2034		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 522,600
Year 25	2035		6	16	15	3	$ 335,000	$ -	$ 70,000	$ 405,000		$ 532,650
Stage I Cost	2011-2020		42	112	105	21	$ 2,345,000	$ -	$ 560,000	**$ 2,905,000**	**Stage I NPV**	$ 1,681,926
Stage II Cost	2021-2036		90	240	225	45	$ 5,025,000	$ -	$ 1,050,000	**$ 6,075,000**	**Stage II NPV**	$ 2,119,932
Total Through 2036	2011-2036		132	352	330	66	7,370,000	-	1,610,000	**8,980,000**	**Stage I+II NPV**	$ 3,801,858

Table F.19. NC DOT Conservative Cost Data Input Chart

	NCDOT Export Rate lbs/ac/year	TMDL Export Rate Target lbs/ac/year	Sum of SW Control Nutrient Removed (lbs/year)
Total Nitrogen	3.17	2.1	14.58
Total Phosphorus	0.53	0.3	2.61

User Input | Known Input | Calculated Output

Stormwater Control	TN Removal Rate	TP Removal Rate	Projected Number of Stormwater Controls	Average Drainage Area (acres)	TN Mass Removed (lbs/year)	TP Mass Removed (lbs/year)	Information Used to Develop Weighted Cost Analysis: TN Removal x Number of SW Controls	TP Removal x Number of SW Controls	Number of SW Controls x Average Drainage Area
Stormwater Wetland	40%	40%	1	4	5.07	0.85	0.4	0.4	4
Bioretention Basin	40%	45%	1	2	2.54	0.48	0.4	0.45	2
Wet Detention Basin	40%	40%	1	3	3.80	0.64	0.4	0.4	3
Sand Filter	35%	45%		0.5	0.00	0.00	0	0	0
Filter Strip	20%	35%	1	1.5	0.95	0.28	0.2	0.35	1.5
Grassed Swale	20%	20%	1	1.5	0.95	0.16	0.2	0.2	1.5
Restored Buffer	30%	35%		3	0.00	0.00	0	0	0
Infiltration Basin	30%	35%		2	0.00	0.00	0	0	0
Dry Detention Basin	10%	10%	1	4	1.27	0.21	0.1	0.1	4
Sum			6		14.6	2.6	1.7	1.9	16

Stormwater Control	Design/ Engineering Cost ($ per acre drainage area)	Construction Cost ($ per acre drainage area)	Design/ Engineering/ Construction Cost (per SW Control)	Annual Cost for Design, Engineering, and Construction	Frequent Maintenance Cost (routine and annual inspection)	Infrequent Maintenance Cost (assumed once every 5 years)	Year 4 Total Cost	Five-Year Total Cost	22-yr construction cost w/ maint. (2036) Total Cost
Stormwater Wetland	$ 9,000	$ 24,000	$ 132,000	$ 132,000	$ 600	$ 15,500	$ 132,600	$ 265,800	$ 3,820,400
Bioretention Basin	$ 17,500	$ 50,000	$ 135,000	$ 135,000	$ 700	$ 6,000	$ 135,700	$ 272,100	$ 3,483,300
Wet Detention Basin	$ 7,333	$ 13,000	$ 61,000	$ 61,000	$ 600	$ 15,500	$ 61,600	$ 123,800	$ 2,258,400
Sand Filter	$ 82,000	$ 186,000	$ 134,000	$ -	$ 300	$ 3,000	$ -	$ -	$ -
Filter Strip	$ 11,333	$ 32,000	$ 65,000	$ 65,000	$ 800	$ 4,000	$ 65,800	$ 132,400	$ 1,885,200
Grassed Swale	$ 8,000	$ 9,333	$ 26,000	$ 26,000	$ 600	$ 2,000	$ 26,600	$ 53,800	$ 867,400
Restored Buffer	$ 14,333	$ 33,000	$ 142,000	$ -	$ 600	$ 2,000	$ -	$ -	$ -
Infiltration Basin	$ 13,500	$ 26,000	$ 79,000	$ -	$ 300	$ 7,000	$ -	$ -	$ -
Dry Detention Basin	$ 5,750	$ 13,000	$ 75,000	$ 75,000	$ 600	$ 7,000	$ 75,600	$ 151,800	$ 2,175,400
Sum			$ 849,000	$ 494,000	$ 5,100	$ 62,000	$ 497,900	$ 999,700	$ 14,490,100
						Average-Weighted Cost per SW Control	$ 82,983	$ 33,323	$ 109,773
							Average-Weighted TN Removal Rate		28%
							Average-Weighted TP Removal Rate		32%
							Average-Weighted Drainage (acres)		2.7

Notes:

1. See the '$Range' tab for the origin of and information pertaining to Design/Engineering and Construction Costs listed in columns C and D.
2. Design/engineering/construction cost (per SW Control) is the capital cost per acre times the average drainage area in acres for each BMP type.
3. Wet Detention Basin construction costs derived from WERF model because BSP costs were unavailable.
4. Level spreader cost used for filter strip.
5. The Annual Cost for Design, Engineering, and Construction is the capital cost for the average drainage area of each BMP times the project number of stormwater controls for each BMP.
6. All maintenance costs are provided as a lump sum, per-BMP cost (not per-drainage area)
7. Routine maintenance costs are based on data provided by NCDOT Div 2 and 4. Where maintenance costs were not available for certain BMPs, costs from a similar BMP was applied.
8. Routine maintenance cost includes an additional $100 for annual inspections, which is a conservative estimate based on NCDOT provided information.
9. Infrequent maintenance costs are based on applicable WERF models and applied between similar BMPs where WERF model costs were unavailable.
10. The Annual Cost for Frequent Maintenance is the frequent maintenance cost times the project number of stormwater controls for each BMP.
11. The 5-year Cost for Infrequent Maintenance is the maintenance cost times the project number of stormwater controls for each BMP.
12. Existing nutrient loads from NCDOT ROW are assumed to remain constant. Changes in nutrient depostion to the ROW (eg atmostpheric) are not considered in this analysis.
13. Construction cost for the Restored Buffer derived from the inverse of the BSP regression for design vs construction costs for $24,000 design cost.
14. Discount and inflation rates as well as land aquistion costs are not included in any of the costs provided.
15. Although the costs are presented as $/acre, it may not be appropriate to apply them to acreage other than the average drainage area listed since some costs were based on average construction costs and not correlated to drainage area except for the purposes of this application.

Table F. 20. NC DOT Conservative Cost Total Analysis Summary

Date			Loading Analysis				Cost Analysis to achieve flat rate BMP implementation requirements					Cost Analysis to achie	
			Number of Stormw ate r Controls Built	NCDOT Area Treated by SW Controls (acres)	Total Nitrogen Load Reduction (pounds)	Total Phosphorus Load Reduction (pounds)	Captial: Design, Engineering, and Construction Costs	Operation & Maintenance: (routine, annual, and life-cycle costs)	Planning / Opportunity Cost (Assumes Equivalent of 1 Staff Position)	Total cost to comply w ith BMP implementation rate requirements		Captial: Design, Engineering, and Construction Costs	Operation & Maintenance: (routine, annual, and life-cycle costs)
Year 1	2011	Stormwater Management Program Development					$ -	$ -	$ -	$ -		$ -	$ -
Year 2	2012						$ -	$ -	$ -	$ -		$ -	$ -
Year 3	2013						$ -	$ -	$ 210,000	$ 210,000		$ -	$ -
Year 4	2014		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 533,520	$ -
Year 5	2015		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 543,400	$ -
Year 6	2016		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 558,220	$ -
Year 7	2017		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 568,100	$ -
Year 8	2018		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 577,980	$ -
Year 9	2019		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 587,860	$ -
Year 10	2020		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 597,740	$ -
Year 11	2021		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 607,620	$ -
Year 12	2022		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 617,500	$ -
Year 13	2023		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 627,380	$ -
Year 14	2024		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 637,260	$ -
Year 15	2025		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 652,080	$ -
Year 16	2026		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 661,960	$ -
Year 17	2027		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 676,780	$ -
Year 18	2028		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 686,660	$ -
Year 19	2029		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 701,480	$ -
Year 20	2030		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 716,300	$ -
Year 21	2031		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 726,180	$ -
Year 22	2032		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 741,000	$ -
Year 23	2033		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 755,820	$ -
Year 24	2034		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 770,640	$ -
Year 25	2035		6	16	15	3	$ 494,000	$ -	$ 210,000	$ 704,000		$ 785,460	$ -
Stage I Cost	2011-2020		42	112	105	21	$ 3,458,000	$ -	$ 1,680,000	$ 5,138,000	Stage I NPV	$ 2,480,213	$ -
Stage II Cost	2021-2036		90	240	225	45	$ 10,868,000	$ -	$ 4,830,000	$ 15,698,000	Stage II NPV	$ 3,126,109	$ -
Total Through 2036	2011-2036		132	352	330	66	$ 4,499,310	$ -	$ 1,912,662	$ 6,411,971	Stage I+II NPV	$ 5,606,323	$ -

Table F.21. NC DOT Best and Conservative Estimated Maintenance Cost of Falls Lake Rule

NCDOT Costs Associated with Falls Lake Nutrient Rule Compliance (Low Estimate)

April 2010

			Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Total
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	
Total Cost for Frequent and Infrequent Maintenance			$ -	$ -	$ -	$ 3,163	$ 6,326	$ 18,978	$ 22,141	$ 49,204	$ 52,367	$ 55,530	$ 58,693	$ 61,856	$ 88,919	$ 92,082	$ 95,245	$ 98,408	$ 101,571	$ 128,634	$ 131,797	$ 134,960	$ 138,123	$ 141,286	$ 168,349	$ 171,512	$ 174,675	$ 177,838	$ 2,171,657
Highlighted Cells are linked to "FallsLk SW Controls-Low" worksheet																													
			0	0	0	1	2	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	
Stormwater Control	**Projected Number of Stormwater Controls**	**Frequent Maintenance Cost (routine and annual inspection)**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Year 11**	**Year 12**	**Year 13**	**Year 14**	**Year 15**	**Year 16**	**Year 17**	**Year 18**	**Year 19**	**Year 20**	**Year 21**	**Year 22**	**Year 23**	**Year 24**	**Year 25**	**Year 26**	**Total**
Stormwater	1	$ 537	$ -	$ -	$ -	$ 537	$ 1,074	$ 3,222	$ 3,759	$ 4,296	$ 4,833	$ 5,370	$ 5,907	$ 6,444	$ 6,981	$ 7,518	$ 8,055	$ 8,592	$ 9,129	$ 9,666	$ 10,203	$ 10,740	$ 11,277	$ 11,814	$ 12,351	$ 12,888	$ 13,425	$ 13,962	$ 182,043
Bioretention Basin	1	$ 591	$ -	$ -	$ -	$ 591	$ 1,182	$ 3,546	$ 4,137	$ 4,728	$ 5,319	$ 5,910	$ 6,501	$ 7,092	$ 7,683	$ 8,274	$ 8,865	$ 9,456	$ 10,047	$ 10,638	$ 11,229	$ 11,820	$ 12,411	$ 13,002	$ 13,593	$ 14,184	$ 14,775	$ 15,366	$ 200,349
Wet Detention	1	$ 537	$ -	$ -	$ -	$ 537	$ 1,074	$ 3,222	$ 3,759	$ 4,296	$ 4,833	$ 5,370	$ 5,907	$ 6,444	$ 6,981	$ 7,518	$ 8,055	$ 8,592	$ 9,129	$ 9,666	$ 10,203	$ 10,740	$ 11,277	$ 11,814	$ 12,351	$ 12,888	$ 13,425	$ 13,962	$ 182,043
Sand Filter	0	$ 250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Filter Strip	1	$ 711	$ -	$ -	$ -	$ 711	$ 1,422	$ 4,266	$ 4,977	$ 5,688	$ 6,399	$ 7,110	$ 7,821	$ 8,532	$ 9,243	$ 9,954	$ 10,665	$ 11,376	$ 12,087	$ 12,798	$ 13,509	$ 14,220	$ 14,931	$ 15,642	$ 16,353	$ 17,064	$ 17,775	$ 18,486	$ 241,029
Grassed Swale	1	$ 250	$ -	$ -	$ -	$ 250	$ 500	$ 1,500	$ 1,750	$ 2,000	$ 2,250	$ 2,500	$ 2,750	$ 3,000	$ 3,250	$ 3,500	$ 3,750	$ 4,000	$ 4,250	$ 4,500	$ 4,750	$ 5,000	$ 5,250	$ 5,500	$ 5,750	$ 6,000	$ 6,250	$ 6,500	$ 84,750
Restored Buffer	0	$ 250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Infiltration Basin	0	$ 250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dry Detention	1	$ 537	$ -	$ -	$ -	$ 537	$ 1,074	$ 3,222	$ 3,759	$ 4,296	$ 4,833	$ 5,370	$ 5,907	$ 6,444	$ 6,981	$ 7,518	$ 8,055	$ 8,592	$ 9,129	$ 9,666	$ 10,203	$ 10,740	$ 11,277	$ 11,814	$ 12,351	$ 12,888	$ 13,425	$ 13,962	$ 182,043
Sum	**6**	**$ 3,913**	**$ -**	**$ -**	**$ -**	**$ 3,163**	**$ 6,326**	**$ 18,978**	**$ 22,141**	**$ 25,304**	**$ 28,467**	**$ 31,630**	**$ 34,793**	**$ 37,956**	**$ 41,119**	**$ 44,282**	**$ 47,445**	**$ 50,608**	**$ 53,771**	**$ 56,934**	**$ 60,097**	**$ 63,260**	**$ 66,423**	**$ 69,586**	**$ 72,749**	**$ 75,912**	**$ 79,075**	**$ 82,238**	**$ 1,072,257**
			0	0	0	0	0	0	0	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	4	4	4	4	
Stormwater Control	Projected Number of Stormwater Controls	**Infrequent Maintenance Cost (assumed once every 5 years)**	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15	Year 16	Year 17	Year 18	Year 19	Year 20	Year 21	Year 22	Year 23	Year 24	Year 25	Year 26	Total
Stormwater	$ 1	$ 7,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 21,000	$ 21,000	$ 21,000	$ 21,000	$ 21,000	$ 28,000	$ 28,000	$ 28,000	$ 28,000	$ 322,000
Bioretention Basin	$ 1	$ 2,900	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,900	$ 2,900	$ 2,900	$ 2,900	$ 2,900	$ 5,800	$ 5,800	$ 5,800	$ 5,800	$ 5,800	$ 8,700	$ 8,700	$ 8,700	$ 8,700	$ 8,700	$ 11,600	$ 11,600	$ 11,600	$ 11,600	$ 133,400
Wet Detention	$ 1	$ 7,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 7,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 14,000	$ 21,000	$ 21,000	$ 21,000	$ 21,000	$ 21,000	$ 28,000	$ 28,000	$ 28,000	$ 28,000	$ 322,000
Sand Filter	$ -	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Filter Strip	$ 1	$ 1,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 3,000	$ 4,000	$ 4,000	$ 4,000	$ 4,000	$ 46,000
Grassed Swale	$ 1	$ 500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 500	$ 500	$ 500	$ 500	$ 500	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,000	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 23,000
Restored Buffer	$ -	$ 500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Infiltration Basin	$ -	$ 5,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Dry Detention	$ 1	$ 5,500	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,500	$ 5,500	$ 5,500	$ 5,500	$ 5,500	$ 11,000	$ 11,000	$ 11,000	$ 11,000	$ 11,000	$ 16,500	$ 16,500	$ 16,500	$ 16,500	$ 16,500	$ 22,000	$ 22,000	$ 22,000	$ 22,000	$ 253,000
Sum	**$ 6**	**$ 30,900**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ 23,900**	**$ 23,900**	**$ 23,900**	**$ 23,900**	**$ 23,900**	**$ 47,800**	**$ 47,800**	**$ 47,800**	**$ 47,800**	**$ 47,800**	**$ 71,700**	**$ 71,700**	**$ 71,700**	**$ 71,700**	**$ 71,700**	**$ 95,600**	**$ 95,600**	**$ 95,600**	**$ 95,600**	**$ 1,099,400**

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Appendix G: Fertilizer Management

Not Applicable

ADDENDUM

Significant Changes to Cost Estimates provided in the Fiscal Note for Falls of Neuse Reservoir Nutrient Strategy DENR/ Division of Water Quality

(15A NCAC 2B .0235, .0275-83, .0315)

December 20, 2010

As a result of the public hearing process for the proposed Nutrient Strategy rules for the Falls of Neuse Reservoir, the Hearing Officers recommend several changes to the rule text. Below is a brief summary of the recommended changes that impact the costs estimated in the fiscal note from June 14, 2010.

.0275, Scope and Purpose – 2025 Report to Commission on Stage I Implementation

The Hearing Officers have enhanced adaptive management provisions in .0275 to ensure that Stage II implementation is not undertaken without a better understanding of the Lake's response to Stage I implementation efforts, the level of effort needed and what is feasible in Stage II, and whether alternative regulatory action would be sufficient to protect existing uses of the Lake. The 2025 Report could result in some additional small costs related to DENR staff time needed to prepare the Report, as well as some changes in the estimates Stage II costs if another Stage II strategy emerges as a result of the Report. While it is unclear what effect potential changes to Stage II strategy would have on benefits, the Report is not intended to delay water quality improvements. The Report is not meant to stop Stage II from beginning after Stage I ends, but rather refine it based on the findings of the Report.

.0278 and .0281, Stormwater Requirements for New Developments – Unclear effect on smaller developers

After comments from the local governments, the Hearing Officers recommended two changes to stormwater requirements for new development:

1) A lowered disturbance thresholds requiring permits from ½ acre for commercial/industrial development and 1 acre for residential development to ¼ acre for both, and
2) Smaller sites between ¼ and 1 acre need to treat only 30% of both nitrogen and phosphorus loads onsite, while sites larger than one acre are required to treat 50% onsite.

The changes are a compromise between the options originally published for public comment. The option to buy possibly more cost-effective reduction offsite might decrease costs to some developers; however, more permits would be required under the new changes, which would increase costs. These changes are unlikely to have an impact on water quality benefits. Ultimately the reduction required is the same, with the difference being that a developer can go offsite to purchase further reductions after achieving onsite reduction goal.

.0280, Agriculture – Decrease of $1 - $4.5 million

The change recommended for the agriculture operations represents a significant decrease of $1-4.5 million in implementation costs. A requirement was removed for residuals application based on soil phosphorus loss risk assessment (using Phosphorous Loss Assessment Tool – PLAT) and replaced by a reporting requirement for soil phosphorus data. This change was made after public comments and industry experts pointed out that PLAT is not designed to work on municipal wastes. The intent of the

rule change is to require land application sites to provide annual data on their soil test phosphorous results and application rates of phosphorous. This information, coupled with ongoing research, should result in development of an accounting tool similar to PLAT that is suitable and scientifically defensible for use on municipal land application sites. DENR anticipates having such a tool within the next 18-24 months that can then be used for the purpose of making sure land application sites apply phosphorous at rates that do not promote runoff of nutrients.

Savings to local governments and wastewater utilities would come from avoided acreage acquisition, hauling and spreading costs and associated transaction costs. The basis of the cost estimate is the approved fiscal analysis from June 14, 2010 and comments during the rulemaking. The fiscal analysis estimated new costs for this rule element at $3.5 - $4.5 million. The low end of the range above is taken from City of Durham comments during the rulemaking. The revision to .0280 should have limited impact on the long term benefits of rule implementation.

.0283, Fertilizer Management – Elimination of Rule

The Hearing Officers recommended eliminating the proposed rule fertilizer management. The fiscal note from June 14, 2010 identified minimal costs from this rule. The rule was proposing that beginning three years after effective date, the application of fertilizer to lands in the watershed (other than application by homeowner to a residential property) be done either by applicators that have completed nutrient management training offered by the Cooperative Extension Service, or pursuant to a certified nutrient management plan developed for the lands to which fertilizer is applied. The proposed rule would have also required property owners to ensure that applicators to their lands have met one of these requirements. Wastewater residuals and septage application would have had earlier compliance timeframes.

The elimination of this rule will lead to some minimal costs to be avoided and will is not anticipated to negatively impact benefits. The Hearing Officers eliminated this rule based on input from technical experts at NC State University, who indicated that the vast majority of, if not all, the people who would be subject to this rule have already taken the nutrient management training under the existing Neuse Nutrient Management Rule. In addition to this, there were concerns that requiring farmers to have fertilizer management plans in a watershed dominated by passively managed pasture may have the unintended effect of actually promoting more fertilizer to be used given pasture is passively managed and largely not fertilized at this point.

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